

Dell Dispatch Training for Printers

Contents

Overview	5
Welcome	5
Prerequisites	5
Course Contents	7
<i>Safety Precautions</i>	7
Standby Power	8
Safety Precautions: Lifting Equipment	8
Using a Wrist Strap	9
Introduction	10
Learning Objectives	10
Workgroup Printers	11
Determining Where to Install a Printer	12
Laser Printers	13
Workgroup Printing	14
Multifunction Printers	14
Printing Overview	15
Review	17
Printing Process: Overview	18
Learning Objectives	18
Printing Overview	18
Printing from the Client	18
Drivers	19
Page Description Languages	20
Xerographic Process	21
The Network	21
The Printer's Role	21
The Image Engine	23
Charge	24

Expose.....	24
Develop.....	26
Transfer.....	27
Neutralize.....	28
Clean	29
Color Printing	31
Printing in Color	31
One or Four Pass Printing	32
Rotary Compositing	33
Tandem Xerography.....	33
5000-Series Color Laser Printers	34
Media Path.....	35
Media Trays.....	37
Rollers and Belts.....	38
The Fuser.....	39
The Duplexer.....	39
The Exit Tray.....	41
Review.....	41
Networking Workgroup Printers	45
Learning Objectives.....	45
Network Installation	45
FAX Setup.....	46
Printer Location.....	46
Remote or Direct to the Print Server.....	47
Dynamic or Static IP	48
Wired or Wireless Networking	48
Embedded Web Server	49
ColorTrack™	50
ColorTrack2™	51
Dell OpenManage™ Printer Manager.....	52
Review	52
Troubleshooting: Overview	55
Learning Objectives.....	55

Dell Support	55
Dell Support: Decision Trees and Journal IDs	56
Error Messages	56
Symptom-Based Troubleshooting	58
Gathering Information	58
Categorizing Symptoms	59
Printer Diagnostic Modes	61
Digital Input/Output Test.....	62
Manual Feed Test	62
Jams and Misfeeds.....	63
Causes of Jams	65
Troubleshooting Jams.....	66
Tips for Clearing Jams and Misfeeds.....	67
Image Quality Issues	68
Perception and expectations	68
Configuration.....	68
Media quality.....	68
Contamination	69
Device failure	69
Troubleshooting Print Quality Issues.....	69
Blank pages	69
Completely or partially black output	69
Faded image on left and right sides of the page.....	70
Horizontal streaks	70
Horizontal deletions.....	70
Incomplete fusing	70
Light print.....	71
Random deletions	71
Random spots	71
Vertical deletions	71
Vertical streaks.....	71
Noise Issues.....	72
Media	73

Curl.....	73
Fiber Content	74
Grain Direction.....	74
Determine Grain Direction	75
Moisture Content	75
Paper Dust and Contaminants	75
Recycled Paper	76
Smoothness	76
Review	78

Overview

Welcome

This course introduces laser printer technologies. Based on current Dell offerings, it describes the technologies, common points of failure, and basic troubleshooting procedures using current workgroup lasers as examples.

After completing this course, you will be able to:

- Define common printer terms and acronyms
- Identify the customer-serviceable components of Dell Workgroup printers
- Describe the print process, including:
 - The xerographic method
 - Paper paths
- Explain how to set up and configure Dell Workgroup laser printers
- Describe the troubleshooting process for common symptoms

Prerequisites

There are no prerequisites for this course. However, you should already know:

- How to install the operating system used at your company and how to install device drivers in that operating system.
- The wired or wireless network configuration your company uses and how to attach networked devices to that network using both static addresses and DHCP.

- How to connect a printer directly to a computer via a parallel or USB cable and install the appropriate printer drivers.

If you do not know some of these things, you can still take the course. However, it may not answer all of your questions.

Course Contents

The following modules comprise this course:

1. Introduction: Provides an overview of workgroup printing
2. Printing: Describes the xerographic method of laser printing and the variants that enable four-color printing. It covers all subsystems used in the print process, including:
 - The client computer
 - The imaging engine
 - The media path
3. Networking: Describes the role of the network in printing. Topics include:
 - Wired and wireless networking
 - The Embedded Web Server (EWS)
 - The ColorTrack™ management system
 - OpenManage™ Printer Manager
4. Troubleshooting: Describes the troubleshooting process for resolving common printer issues, including:
 - Print quality issues
 - Jams and misfeeds
 - Noise
 - Media
5. Review: Reviews the major points of this course in preparation for taking the assessment
6. Assessment: Provides an opportunity for you to demonstrate your mastery of the course objectives
 - To receive credit for this course, you must pass the exit assessment with a score of 80% or higher.



Safety Precautions

Observe the following safety precautions before performing any installation or break/fix procedures involving disassembly or re-assembly:

- Turn off the system and any attached peripherals.

- Disconnect the system and any attached peripherals from AC power.
- Disconnect any telephone or telecommunications lines from the system.
- Use a wrist grounding strap and mat when working inside any computer system to avoid electrostatic discharge (ESD) damage.
- After removing any system component, carefully place the removed component on an anti-static mat.
- Wear shoes with non-conductive rubber soles to help reduce the chance of being shocked or seriously injured in an electrical accident.

Standby Power

Dell products with standby power must be completely unplugged before opening the case. Systems that incorporate standby power are essentially powered while turned off. The internal power allows the system to be remotely turned on (wake on LAN), to be suspended into a sleep mode, and to have other advanced power management features. After unplugging the system, allow the charge to drain from the circuits by waiting approximately 30 to 45 seconds before removing components.

Safety Precautions: Lifting Equipment

Adhere to the following guidelines when lifting equipment:

- Get a firm balanced footing. Keep your feet apart for a stable base, and point your toes out.
- Bend your knees. Do not bend at the waist.
- Tighten stomach muscles. Abdominal muscles support your spine when you lift, offsetting the force of the load.
- Lift with your legs, not your back.
- Keep the load close. The closer it is to your spine, the less force it exerts on your back.
- Keep your back upright, whether lifting or setting down the load. Do not add the weight of your body to the load. Avoid twisting your body and back.

Follow the same techniques in reverse to set the load down.

WARNING: Do not lift greater than 50 pounds independently. Always obtain assistance from a second person or use a mechanical lifting device.

Using a Wrist Strap

Electrostatic Discharge (ESD) is a sudden transfer of electrostatic charge between bodies at different electrostatic potential -usually as a spark as the bodies approach one another.

ESD is a major concern when handling components, especially expansion cards and system boards. Very slight charges can damage circuits. Damage from ESD can occur immediately, or it may not become apparent for some time. ESD may also cause intermittent problems or a shortened product lifespan.

When working with the electronic subsystem (ESS), use an ESD strap.

- While the system is plugged into the Earth circuit via the power socket, attach the wrist-grounding to your wrist and clip the other end to a ground object.
- Unplug the machine.
- If a strap is not available, discharge static electricity from your body before you touch any of your computer's electronic components, by touching an unpainted metal surface on the computer chassis. Periodically touch an unpainted metal surface to remove any static charge your body may have accumulated.
- Handle all static-sensitive components in a static-safe area. If possible, use antistatic floor pads and workbench pads.
- When handling static-sensitive components, grab them by the sides, not the top. Avoid touching pins and circuit boards.
- When unpacking a static-sensitive component from its shipping carton, do not remove the component from the antistatic packing material until you are ready to install the component. Before unwrapping the antistatic packaging, be sure to discharge static electricity from your body.
- •Before transporting a static-sensitive component, place it in an antistatic container or packaging.

Introduction

Learning Objectives

This module explores workgroup printing. After completing this topic, you will be able to:

- Determine an adequate location for installing a printer
- Define the characteristics of workgroup printing and workgroup laser printers



Workgroup Printers

Just as you could install a server operating system on a desktop (or even a notebook) and use it as a server, many personal printers have embedded networking and print server functionality. The qualities that make a printer a workgroup printer have a lot in common with what makes a computer a server.

Network Interface:

- Embedded print server and Web configuration interface
- Support for Ethernet wired networks

Ability to handle large volumes of information:

- Up to 55 pages per minute (PPM)
- Toner cartridges rated up to 19,000 pages



All current workgroup laser printers have an RJ-45 and USB port, but not all have an RJ-11 or parallel port.

- Sheet feeders capable of up to 1,000 pages (maximum combined capacity of more than 2,000 pages for all trays)
- Expandable memory
- Optional hard drives

Reliability under heavy use:

- Engineered for 24/7 operation

Duty cycle:

- Up to 150,000 pages per month under normal operation

Workgroup Printers

Most currently shipping Dell laser and ink printers have some kind of network support. Dell workgroup laser printers are in the 3000-, 5000-, and 7000 series. The 1000-series laser printers are considered personal printers, even though they have network capabilities and can support multiple users. No ink printers are considered workgroup printers.

All current workgroup laser printers have an RJ-45 and USB port, but not all have an RJ-11 (FAX) or parallel port.

Determining Where to Install a Printer

Many factors determine where your printers are installed. Each printer model may have unique installation requirements. Always check your printer's *Owner's Manual* or *Service Manual* for specific installation instructions.

While this topic does not cover the specifics of installing any printer, some general considerations apply:

Allow for adequate ventilation.

- Laser printers generate a lot of heat. Avoid enclosures and make sure the printer has plenty of room for air to flow around all sides.
- Most laser printers have vents or fans on the sides and back. Blocking these vents could cause the printer to overheat and shut down.

Place the laser printer on a stable surface.

- Laser printers can be very heavy and can cause bodily injury if they fall on someone.

Make sure the media trays are easily accessible.

- Adding paper should not be a difficult task.

Keep the exit tray clear of all obstructions.

- Obstructions can cause jams and damage finished printouts.

Keep the back of the printer far enough away from the wall.

- You need access to the connectors. Some printers have rear doors or covers that must be opened to clear jams.

Make sure all covers and doors are accessible.

- You access the toner cartridges in some printers, the 5000-series for example, from the top, behind the exit tray. Other printers may have doors or access panels on the sides.

Leave room in front of the printer for the front cover to open.

- You need to open the front cover to access the toner cartridges and other customer-replaceable devices.

Never use a power strip and avoid extension cords.

- Laser printers should never be plugged into a UPS or power strip. If an extension cord is absolutely necessary:
 - Use the shortest possible length that safely supplies the printer.
 - The cord must be rated equal to, or better than, the power rating (amps) of the printer.
 - The (earth) ground must be continuous from the original power source.

Laser Printers

A laser printer is essentially a specialized computer that controls a mechanical printing device. All laser printers contain:

- Electronic subsystem (ESS)
 - A processor
 - Controller card (system board)
 - Memory
 - BIOS (firmware)
 - An operating system (stored in the firmware)
- Communications ports
 - Parallel (becoming less common)
 - RJ-45
 - USB
- Media handling components
- Imaging engine
 - Imaging drum
 - Fuser
 - Laser

Workgroup Printing

You can think of a workgroup laser printer as a print server controlling a high-volume printer.



To meet the needs of the workgroups they serve, workgroup laser printers scale from relatively small networked printers to very large printers. Printers serving larger workgroups may include:

- Expanded memory
- Local storage (hard drive)
- High-capacity media trays
- Multiple output bins

Multifunction Printers

Some printers, such as the 3115cn, are multifunction printers. They include an optional scanner and fax modem. These features enable the printer to function as a fax machine, photocopier, or scanner, as well as a printer.



Some multifunction workgroup printers can even redirect incoming faxes via e-mail, reducing overall printing costs.

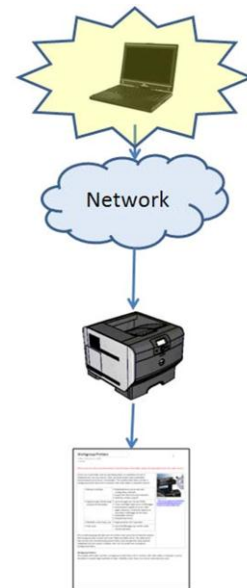
While they make multifunction printers more desirable and cost effective, these additional features also add to the complexity of the printer. Using and troubleshooting the additional features is beyond the scope of this course.

Printing Overview

Printing to a workgroup laser printer is a complex undertaking. It involves a number of systems, any of which could contain multiple points of failure.

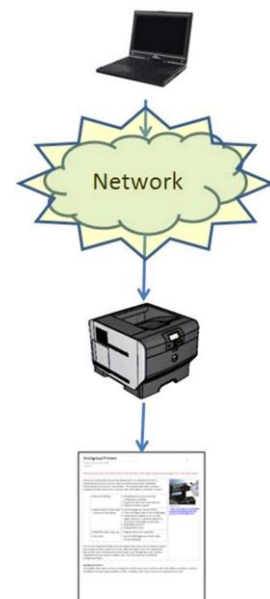
A client system

- The print process starts with a client initiating a print job. The client system must have the correct printer driver installed. It translates the document to be printed into a transmittable form that the printer can interpret. Dell laser printers can interpret a number of protocols and page description languages.
- See the *Owner's Manual* or the printer for instruction on loading the driver to client systems.



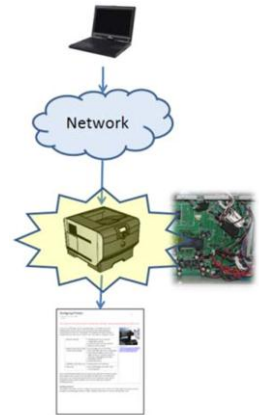
The network infrastructure

- The document travels over the network to the printer. All Dell workgroup laser printers have an embedded NIC. Many also have optional wireless network adapters.
- This course assumes you are already familiar with your network infrastructure and troubleshooting network communication issues.



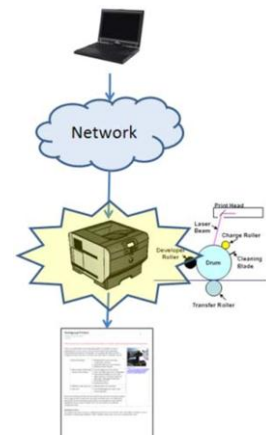
The electronic subsystem (ESS) of the laser printer

- The printer's ESS is the printer's computer section. It includes:
 - System board (controller card)
 - Processor
 - Working memory
 - Sensors
- When the printer receives the document, the computational unit interprets the instructions in the page description language and engages the motor, sensors, print head, and other components needed to print the document.
- For more information on specific components, see your printer's *Owner's Manual* or *Service Manual*.



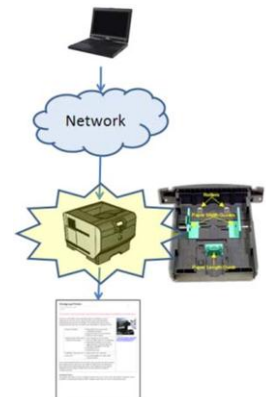
The imaging engine of the laser printer

- The imaging engine is responsible for putting the toner on the print media. It includes:
 - The print head
 - Drum
 - Charge roller
 - Transfer roller (or belt)
 - Fuser
- The ESS fires the laser to change (reduce) the charge on the drum. The reduced charge determines where toner sticks to the drum.
- The transfer roller moves the toner from the charge roller to the media. The fuser melts the toner to the media.
- For more information, see the Printing Process module of this course.



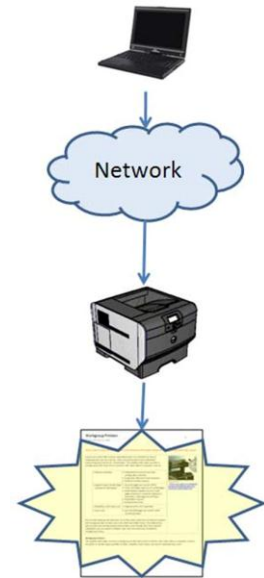
The media handling subsystem of the laser printer

- The media handling subsystem of the laser printer is responsible for moving the media, usually paper, through the printer. Most people are familiar with media trays, but this component also includes a large number of:
 - Sensors
 - Motors
 - Gears
 - Rollers
- For more information about the media handling components, see the Printing Process module of this course.



The physical media

- Especially at the workgroup level, the media is almost always paper, but it can include transparencies, card stock, and other items.
- Media is the most common cause of laser printer issues such as:
 - Poor image quality
 - Jams
 - Misfeeds
- For more information about media, see the Printing Process module of this course.



Review

The qualities that make a printer a workgroup printer have a lot in common with what makes a computer a server.

- The ability to handle large quantities of data
- Reliability under heavy use
- Extended duty cycle

Install laser printers in a safe, accessible location.

- Allow for adequate ventilation.
- Make sure the surface is stable and can support the weight of the printer.
- Make sure all trays, doors, and panels are accessible.
- Do not connect a laser printer to a power strip or UPS.

Laser printers are a combination of mechanical components and the electronics that control them.

Workgroup laser printers serve large groups of people and are designed to function well under heavy workloads.

Multifunction printers incorporate a scanner and fax modem into the printer.

Printing to a workgroup laser printer involves *many potential points of failure*:

- The client system
- The network infrastructure
- The printer's electronic subsystem (ESS)
- The printer's imaging engine
- The printer's media handling subsystem
- The physical media

Printing Process: Overview

Learning Objectives

This module explores the printing process used in Dell laser printers. Specifics are different for each printer, but the concepts are consistent.

After completing this module, you should be able to:

- Describe the xerographic process
 - Explain how the components of the process interact
 - Identify symptoms that could result from failures at any stage of the process
 - Describe the methods of color printing
- Explain how media moves through the printer

Printing Overview

Printing to a workgroup laser printer involves:

- A client system
- The network infrastructure
- The laser printer's electronic subsystem (ESS)
- The laser printer's imaging engine
- The laser printer's media handling subsystem
- The physical media

This module explores each component of the process. Subsequent modules provide more detail on many of the components.



Printing from the Client

Every print job starts at a client computer when a user decides to print the document they are writing or reading.

Below are the elements involved in the print process on the client side.

The application

- The application is responsible for formatting the document to be printed. What you see on the screen is not always what prints.

A page description language

- Dell laser printers support several page description languages. As the term implies, these languages help the application describe what it displays on the screen in terms the printer can understand. For a job to print correctly, the client and the printer must both speak the same page description language.
- One troubleshooting step for print quality issues is to reprint the document using a different page description language. Make sure that the printer and client both support the new choice.

The printer driver

- This course uses the term printer driver loosely to include the Control Panel (Print Properties and Printer Preferences) applets that install with the actual driver. The Print dialog box is part of the application, but it can call either or both of the other two dialog boxes.

NOTE: As used in this document, Control Panel refers to the Windows Control Panel. Operator panel refers to the set of controls physically mounted on the printer that some printer manuals call the control panel.

- Printer drivers are subject to the same corruption issues as any other driver. Ensuring that the client always has the most current printer driver can prevent many printer issues.

The network driver and adapter

- Since workgroup laser printers serve a number of users by default, this course assumes that you are printing over a network connection
- One way to determine if print problems arise from the printer or the network connection is to attach the printer directly to a client computer (all Dell workgroup lasers include a parallel or USB interface). If the job prints correctly when connected directly to a client, the printer hardware is working correctly. You may need to check network settings or hardware.

Printing any of the reports available from the printer's operator panel can quickly eliminate either the printer or the client as the source of a printing issue:

- If the problem persists on the report, troubleshoot the printer.
- If the report prints correctly, troubleshoot the client or the network.

Drivers

Most users interface with printers using an application such as Microsoft™ Word, but the application does not really talk to the printer. It talks to the operating system, which, in turn, talks to the driver. Applications provide a Print dialog box where users can configure the current print job.

The driver translates the instructions from the operating system to something the printer can interpret using a page description



Dell printer drivers use a common installation wizard.

language (PDL). At least one PDL installs with the printer driver. When the driver is installed, it records:

- Whether the printer is connected locally or accessed over the network at a specific IP address or host name.
- Any optional equipment (such as a duplexer) that is installed in the printer.

Users configure the driver using applets:

- Print Properties configures the driver for the current print job.
- Print Preferences configures the driver's default settings for future print jobs.

In most cases, the order of priority from highest to lowest is:

1. Print dialog box (application)
2. Print Properties applet (part of the driver and may not be included in the Print dialog box)
3. Print Preferences applet (part of the driver)
4. Printer Settings (hardware)

In some cases, confusion can arise when one setting, such as media size or tray, overrides another. The easiest way to avoid this confusion is to make sure the settings are the same in all four places.

Page Description Languages

The printer receives instructions from the client system in the form of a page description language (PDL). The printer's electronic subsystem (ESS) then translates these instructions into commands to its internal components.

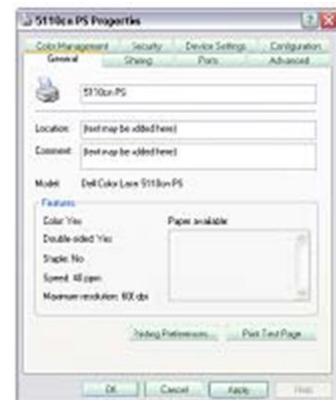
PDLs describe how a printed page should look to the printer. A PDL is a high-level language that includes instructions to the printer. Some PDLs, such as PostScript, are complete enough to be considered programming languages.

There are many PDLs, and most printers support more than one. Among those that Dell workgroup laser printers support are:

- Device Independent (DVI)
- PostScript
- Printer Command Language (PCL)
- XML Printer Specification (XPS)

Each of the supported PDLs may be available in more than one version. Always check your system's *Owner's Manual* or *Service Manual* to determine which PDLs and which versions of the PDLs your printer supports.

Each PDL the printer supports has unique Print Properties and Print



Preferences dialog boxes on the client system.



You choose which PDL to use on the Print dialog box when printing a document. On the Print dialog box, each available PDL may show up as a different printer.

Xerographic Process

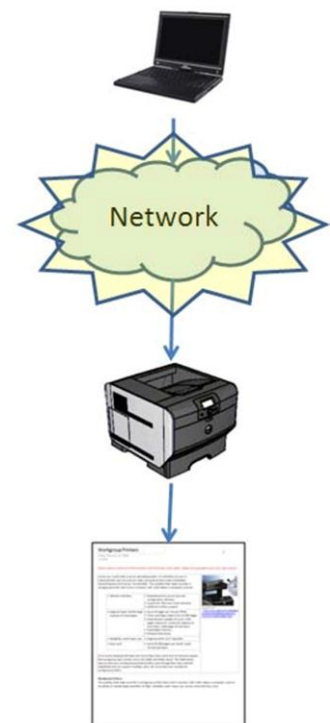
The Network

In most cases, the print job gets to a workgroup laser printer over a wired or wireless network.

Below are ways the printer may be connected to the network:

- *Connect directly to a print server using a USB or parallel cable*
- *Connect to a print server over an Ethernet or wireless network*
- *Connect directly to an Ethernet or wireless network and use its internal print server*

For more information on networks, see the Networking module of this course.



The Printer's Role

Once the print job gets to the printer, three internal systems work together to create the final product:

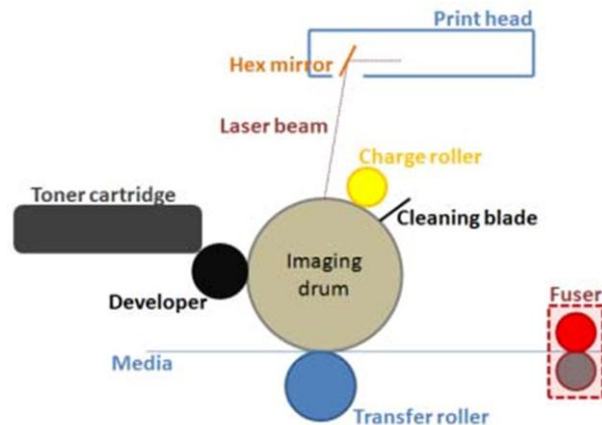
- The electronic subsystem (ESS), which includes the controller card, coordinates the other internal

systems.

- The media handling subsystem moves the media through the feed path, past the imaging engine, through the fuser, and finally into the exit tray.
- The imaging engine (subsystem), which has two functions:
 1. Creating the image of the document on the media
 2. Fusing the image to the media

The Image Engine

Laser printers use the xerographic method (also known as the electro-photographic process) to create an image on media. Xerography uses electrostatics (statically charged devices installed inside the printer at specific points for specific purposes) to move the toner from one place to another. Toner is composed of a blend of plastic and iron particles. This blend allows toner to be moved with charges of electricity and finally fused into the paper.



The thin blue line in this drawing represents the path the media follows from left to right as it passes the drum and surrounding parts.

Xerography is a standardized technology, but specific details may vary among printers. Rather than delving into specific charges, our purpose is better served by describing what happens in more general terms. It doesn't matter whether the charge changes from positive to negative or the other way around; what matters is that the state of the charge changes.

The xerographic process consists of these actions:

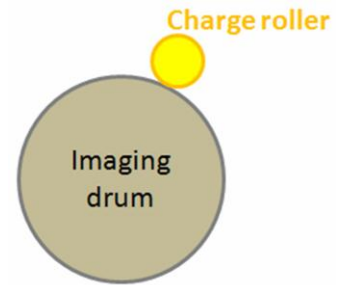
1. Charge the imaging drum.
2. Expose the image with a laser. This may be thought of as drawing the image on the drum.
3. Develop the image with toner.
4. Transfer the toner to the media. Some printers use a secondary transfer belt or drum between the main imaging drum and the media.
5. Neutralize (remove the residual charge from) the media and the drum.
6. Clean the excess toner from the drum.
7. Fuse the toner to the media.

The specific order of the last three actions may vary by printer. In color printers some of these steps may be repeated or multiple iterations may happen simultaneously.

The subsequent discussions use the print process of several Dell color and monochrome printers. Always check your printer's *Owner's Manual* or *Service Manual* for the specific process and components used in your printer.

Charge

The charge roller evenly distributes a negative charge on the imaging drum. This evenly distributed charge acts as the film that is discharged (exposed) by the laser to create the latent image.



Symptoms that a defective charge roller may cause include:

- Black toner streaks, spots, lines, or background fog, which could result from a damaged charge roller. Irregularities appear several times on letter-sized media.
- Completely black pages, which could result from a missing charge roller or one that has completely failed.

The charge roller is usually smaller than the imaging drum. Defects caused by a damaged charge roller repeat at smaller intervals than defects caused by a damaged imaging drum.

The charge roller gets its charge from the high voltage power supply (HVPS). A faulty HVPS or a loose connection between the HVPS and the charge roller can manifest the same symptoms as a failed charge roller.

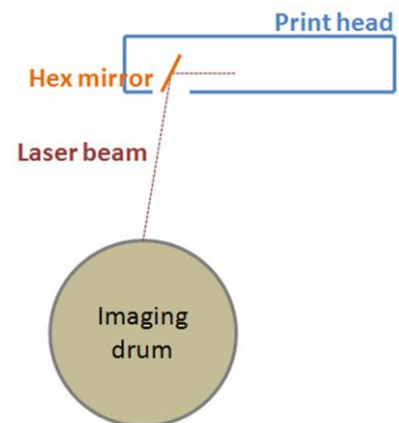
Since the charge roller is in direct contact with the drum, any damage to the charge roller may also damage the drum.

Expose

Laser printers use a laser to draw an image of the document on the imaging drum. The drum is coated in a photoconductive material.

The laser resides in the print head assembly and does not move. Nor does it shine directly on the drum. Instead mirrors and lenses focus the laser on different parts of the drum. Usually, a hexagonal mirror rotates to redirect the laser beam across the drum. Lenses may also help direct the beam to specific spots. Timing is critical because both the drum and the mirror are in motion.

The laser beam scans across the drum while pulsing off and on to discharge specific areas, creating a latent image. A latent image is actually the invisible image formed on the photoconductor (PC)

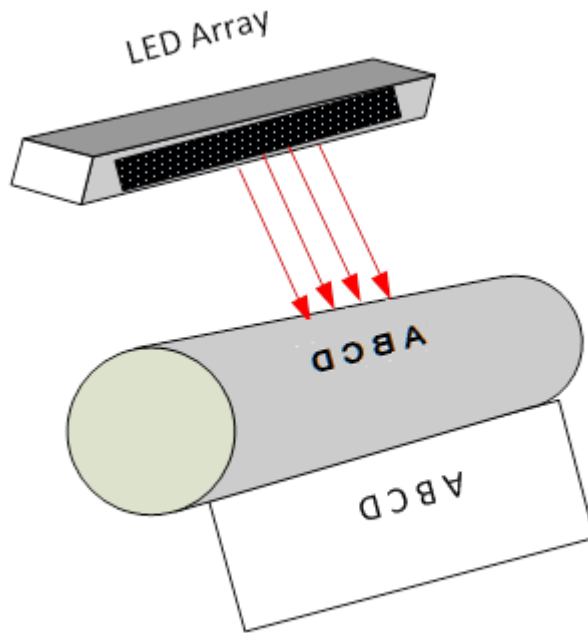


The hex (polygonal) mirror causes the laser to scan across the drum.

surface after being discharged by the laser scan. The areas exposed by the laser beam become positive (or less negative than the surrounding surface). Only the areas on the drum that were exposed to the laser light should attract toner during the Develop stage.

Another xerographic method incorporated in the 7100 series printers uses LED (Light Emitting Diode) technology to create an image on the imaging drum. The technology is much simpler because it uses a stationary array of LEDs instead of all of the moving parts which are required to direct a single laser beam across the drum.

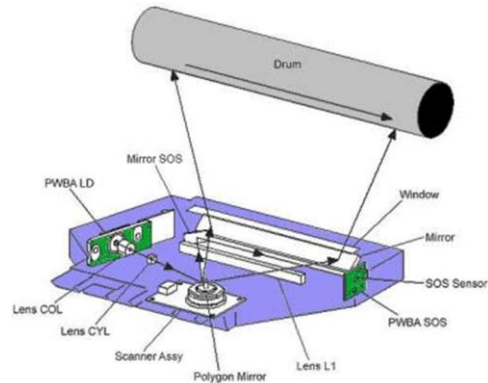
A single line of LEDs are sequenced to turn off and on to create an image across the rotating drum using a process similar to that of line-dot matrix printer. Once the image is created, subsequent development and image transfer to paper is identical to the laser printer xerographic process.



Symptoms of a damaged or malfunctioning drum include:

- Black streaks or lines
- Voids
- White spots (dropouts) on the black test page
- Black spots on the blank page quality test
- Thin solid lines down the page

All of these print defects appear regularly on the printed page. The spacing of the defects varies by printer because the size of the drum varies.



If the laser fails, it cannot discharge the drum. So, output would be nearly or completely blank. A loose power or control connection could cause completely random dropouts. Obstructions of the beam can result in regular dropouts across the page.

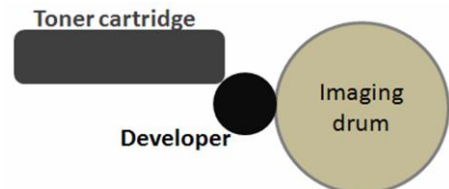
The beam path of the 3000-series of printers is very complex.

Damage or failure of the mirror or its motor can result in:

- Dropouts
- A solid black line
- An unfocused image
- Random background clutter

Develop

While the laser writes the latent image to the imaging drum, the toner cartridge drops toner into the developer assembly. Inside the developer, one or more augers stir the resident toner and move it to the developer roller, which may also be called a magnetic roller or mag roller. The agitation of the toner causes it to acquire a friction charge like the one that accumulates in nylon clothing.



Because the developer is a consumable, it is sometimes part of the toner cartridge.

Toner on the developer roller receives a negative charge as it passes under the doctor blade. The doctor blade (or trimmer blade) removes the excess toner from the developer roller and ensures that the toner spreads evenly across the roller. The developer also receives a negative charge at this time. Because the developer and toner have the same charge, they tend to repel each other.

At transfer, the toner is still a plastic powder. The media acquires some of the positive charge from the transfer roller, but that charge is all that holds the toner to the media until they pass through the fuser. If a jam occurs between the transfer roller and the fuser, the toner may fall off of the media as you clear the jam.

Neutralize

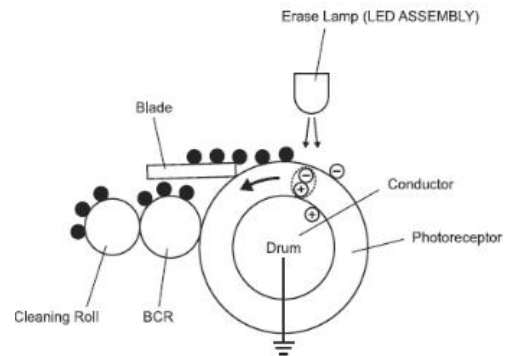
Neutralization is a two-step process. The excess charge must be removed from both the media and the imaging drum.

Any residual charge on the drum surface can:

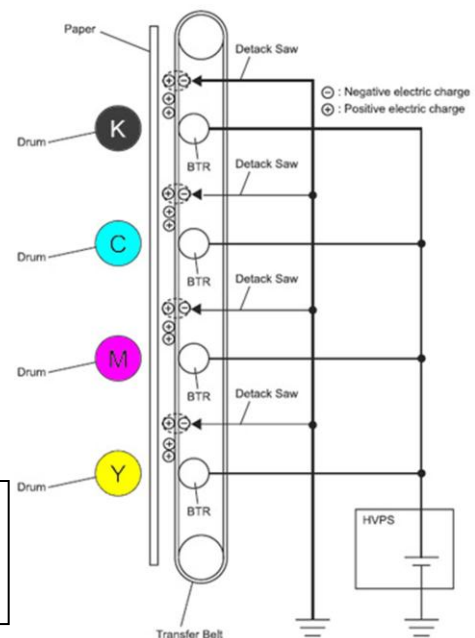
- Hinder the drum from being charged uniformly
- Lead to print defects

Some printers use an erase lamp to remove any excess charge. The erase lamp is an LED or lamp assembly that exposes the drum surface to light. Some printers do not use any specific erase method. Instead, these printers use the characteristics of the transfer process to help erase the drum.

Removing the excess charge from the media is more important when printing in color, but it can cause problems in monochromatic printing. In color printing, the media must be neutralized after each color in the composing process. Failure to do so may cause the media to pick up toner in places where it should not. In monochrome printers, the fuser may also neutralize the media.



In the 3110cn, a lamp removes the excess charge from the drum surface as part of the cleaning process.

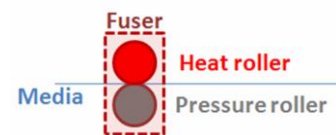


Also in the 3110cn, a detack saw removes excess charge from the media between each color transfer.

Fusing

The fuser bonds the toner to the media by melting the plastic powder and pressing it into the media. The fuser has two main parts:

- The heat roller, which supplies the heat that melts the toner.
- The pressure roller, which presses the media tightly against the heat roller to help ensure that the media is evenly heated and moves through the fuser quickly.



Always use media designed for laser printers. Some media designed for ink printers can damage the fuser beyond repair. The fuser generates enough heat to melt some plasticized media (such as transparencies or vellum). Melted media can adhere to the fuser, wrapping around the heat roller.

Failure of the fuser prevents the toner from adhering to the media. The result can be very messy.

Always let the fuser cool before troubleshooting. The fuser gets very hot. Touching the fuser before it cools can cause severe burns.

If you get toner on your clothing, wash in cold water. Hot water can fuse the toner to your clothing.

Damage to the toner may result in:

- Jams
- Defects that repeat regularly across the page:
 - Smears
 - Streaks
 - Unfused toner (falls off page)

After passing through the fuser, the media may take either of two paths. It may:

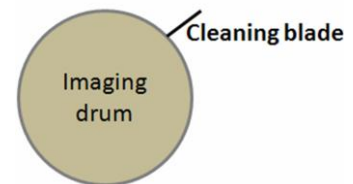
- Enter a duplexer so the other side can be printed
- Exit the feed path into the exit tray

Clean

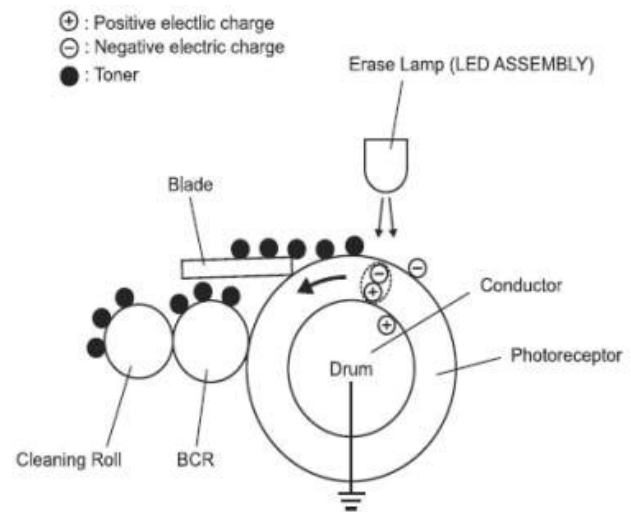
The last step of the repeating cycle is to clean the imaging drum. A cleaning blade wipes residual toner, paper dust, and other debris off of the drum. This toner and dust collects in the waste reservoir or recycles into the developer.

A damaged cleaning blade causes streaks down all or part of the page. Because the cleaning blade contacts the imaging drum, a damaged blade can damage the drum.

The cleaning blade is usually part of the same assembly that houses the imaging drum. Depending on the printer, they may be part of the toner cartridge or housed in a separate cartridge or assembly.



A cleaning blade removes the excess toner from the imaging drum before the drum moves past the charge roller.



The excess toner may be recycled or dumped into a bin to await disposal

Color Printing

Printing in Color

The major differences between monochrome and color printing take place in the imaging system. Color printing composites four colors in varying amounts to form a full color image on the media. The four colors of toner used to print a color image are:

- Cyan (C)
- Magenta (M)
- Yellow (Y)
- Black (K)

The process is similar to a monitor compositing red, green, and blue (RGB) to display an image that contains millions of shades. But monitors use an additive process while printers use a subtractive process.



Printers use subtractive compositing. Each additional layer of color gets closer to black. The addition of true black toner finalizes the transition from dark brown to true black.

In an additive process, color is controlled by luminescence.

- Black is the absence of luminescence.
- White occurs when all colors are fully luminescent.

In a subtractive process, color is formed by the reflection of various frequencies of light.

- White toner does not exist. The absence of color is simply that—white or whatever color the media is.
- Black forms when the toner absorbs all frequencies of light equally.
- There are two methods of printing black:
 1. Black toner
 2. Composite black—mixing cyan, magenta, yellow, and black toner together to form black

Because of the different methods of creating color, what you see on the monitor may not be exactly what comes out of the printer. Printing on media that is neither white nor transparent further compounds color variations.

To help alleviate problems with color variation, color matching schemas have evolved over time.

One or Four Pass Printing

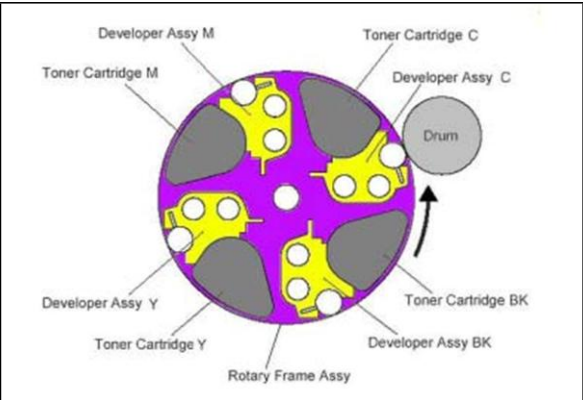
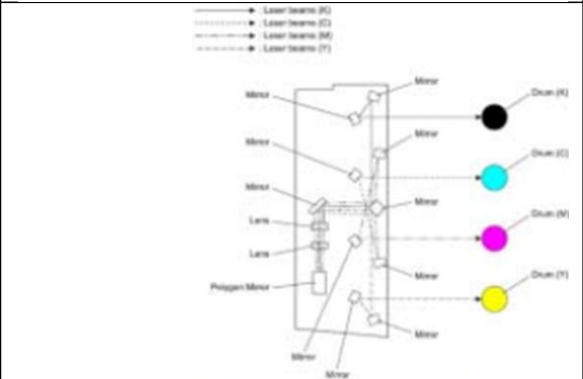
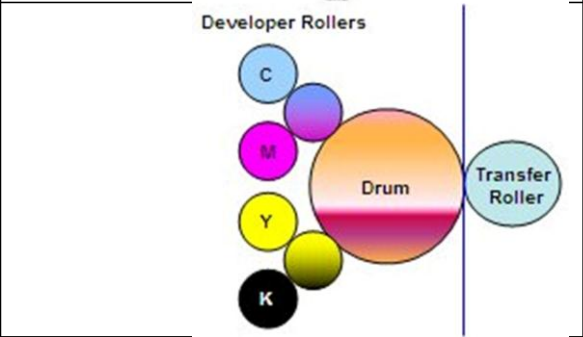
Color printers use two different methods of printing color:

- One-pass printing moves the media through the printer one time per face.
- Four-pass printing moves the media through the printer four times (one for each color) per face.

In both one- and four-pass printing, each of the four colors is imaged and developed separately. All Dell color laser printers use one-pass technology, but they use slightly different methods, each of which is discussed on the subsequent pages of this topic.

- Rotary compositing
- Tandem xerography

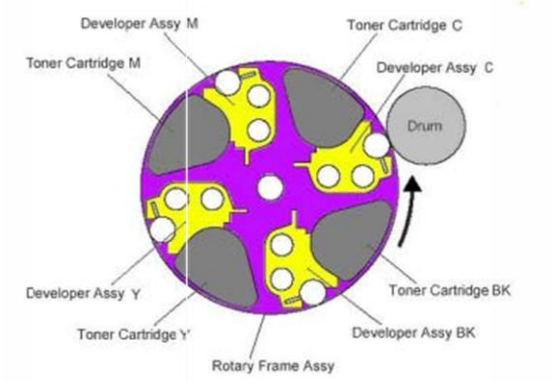
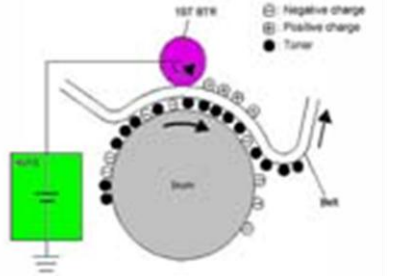
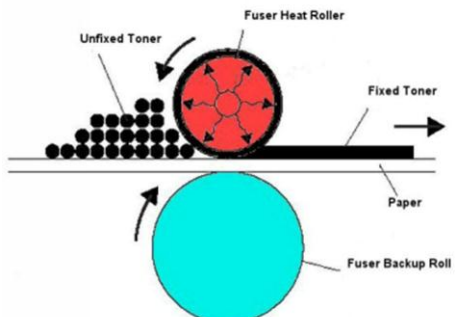
Below are diagrams of methods used by different Dell printer lines.

3000-series	The early 3000-series uses rotary compositing.	 A circular diagram showing a central 'Rotary Frame Assy' with four segments. Each segment contains a 'Developer Assy' (labeled M, C, Y, BK) and a 'Toner Cartridge' (labeled M, C, Y, BK). A 'Drum' is shown on the right, with an arrow indicating its rotation. The segments are arranged in a circle around the drum.
3110cn	The 3110cn uses tandem xerography.	 A schematic diagram of a tandem xerography system. It shows four parallel laser beams (BK, C, M, Y) passing through a series of mirrors and lenses. Each beam is directed to a corresponding drum (BK, C, M, Y) on the right. A 'Polarizer Mirror' is shown at the bottom left. The drums are arranged in a vertical line, and the beams are directed to them in sequence.
5000-series	The 5000-series if color lasers uses intermediate drums to composite the colors. The first set of drums composites four colors down to two. These drums then transfer the composited image to another drum that holds the four-color image for transfer to the media.	 A diagram showing the intermediate drum method. On the left, four 'Developer Rollers' (labeled C, M, Y, K) are shown. These rollers are in contact with a large central 'Drum'. The drum is then in contact with a 'Transfer Roller' on the right. The diagram illustrates how the four colors are composited onto the central drum and then transferred to the media.

Rotary Compositing

The early 3000cn, 3010cn, and 3100cn printers use a three-step process called rotary compositing.

See below for a description of the three steps.

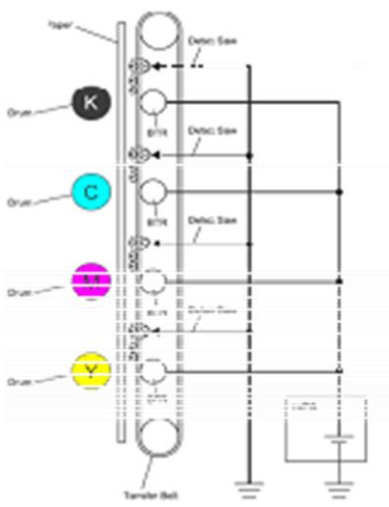
<div>1. Each color toner cartridge and developer resides on a large cylinder. The cylinder rotates to give each color's developer access.</div>	 <p>The diagram shows a circular rotary frame assembly. It features four toner cartridges (Magenta, Cyan, Yellow, and Black) and four corresponding developer assemblies arranged around a central drum. Labels include: Developer Assy M, Toner Cartridge M, Developer Assy Y, Toner Cartridge Y, Developer Assy C, Toner Cartridge C, Developer Assy BK, Toner Cartridge BK, and Rotary Frame Assy. A central drum is also labeled.</p>
<div>2. In a process called intermediate belt transfer (IBT) each color then composites on a belt (also called the IBT) before transferring to the media. A bias transfer roller (BTR) facilitates transferring the toner from the drum to the IBT. The IBT makes four passes over the drum for each printed page.</div>	 <p>The diagram illustrates the IBT process. A drum is shown with toner being transferred to an intermediate belt (IBT) via a bias transfer roller (BTR). The IBT then carries the toner to the media. A legend indicates: Negative charge (circle with minus), Positive charge (circle with plus), and Toner (black dot). A green box labeled 'IBT BTR' is shown on the left.</p>
<div>3. The media passes over the IBT once and then moves on to the fuser or duplexer.</div>	 <p>The diagram shows the fusing process. Unfixed toner is shown on a paper surface. A fuser heat roller (red) and a fuser backup roll (blue) are used to fix the toner onto the paper. The final output is labeled 'Fixed Toner' and 'Paper'.</p>

Tandem Xerography

The 3110cn uses tandem xerography.

This process differs from other color technologies in that each color's developed image is overlaid directly to the final media, instead of an intermediate surface.

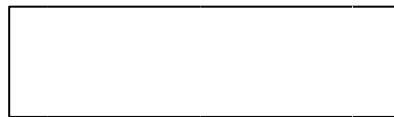
1. The media moves from the registration rollers to the



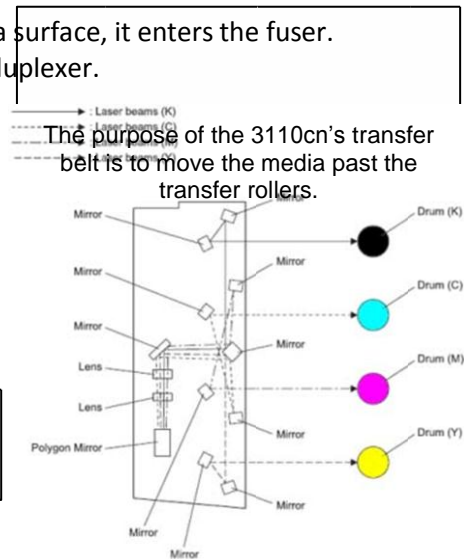
transfer belt, where it is held in place with a high-voltage charge.

2. The media moves upward through the printer, arriving at each color drum when that drum's image is ready. It passes each drum in succession:
 - a. Yellow
 - b. Magenta
 - c. Cyan
 - d. Black
3. After all four colors have been overlaid directly on the media surface, it enters the fuser.
4. After fusing, the media passes either to the exit tray or the duplexer.

The 3100cn essentially has four imaging engines—so that all colors can be printed in one pass through the printer—but only one fuser. Neutralization takes place after each color transfer. A detack saw positioned above each transfer roller removes any excess charge from the media so that it does not interfere with compositing the next color.



As implemented in the 3110cn, the laser's path is very complicated.



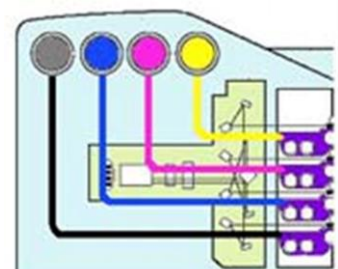
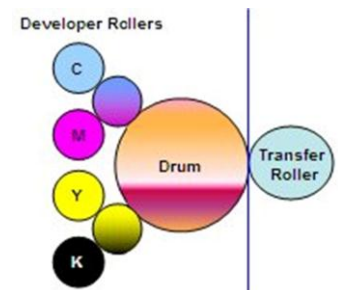
The purpose of the 3110cn's transfer belt is to move the media past the transfer rollers.

5000-Series Color Laser Printers

The 5000-series of color laser printers uses an intermediary tandem compositing system. Each color has a separate developer and imaging drum. Two primary transfer drums—called intermediate drum transfer 1 (IDT1)—each one composites two colors. Finally, the intermediate drum transfer 2 (IDT2) composites the developed images from the two secondary transfer drums into a four-color image.

The media passes through the printer once, going between IDT2 and the bias transfer roller (BTR). Drawing power from the high-voltage power supply (HVPS), the BTR's charge draws the toner from IDT2 and causes it to stick to the media. Still holding the toner with this charge, the media then passes through the fuser.

Another big difference between the 5000-series and other Dell color laser printers is in the developing system. The 5000-series printers use a completely different method of supplying toner to the developers. Toner still comes in cartridges. But the cartridges install far away from the developers. A series of augers and tubes moves the toner from the cartridge to the developer. Toner is always present in these tubes.



The persistent presence of toner is a critical factor in moving 5000-series printers. You must always move the printer with toner cartridges (or cartridge blanks) installed in the cartridge bay. Shipping a 5000-series color printer without the toner cartridges being installed allows the toner in the tubes to escape. It can cover every surface of the printer.



Always ship 5000-series color laser printers with the toner cartridges or cartridge blanks installed. Failure to ship the printer with all toner cartridges installed and locked down can cause irreparable damage to the printer. When a printer is being returned to Dell, toner cartridges or dummy cartridges (provided when Dell replaces the printer) must be installed.

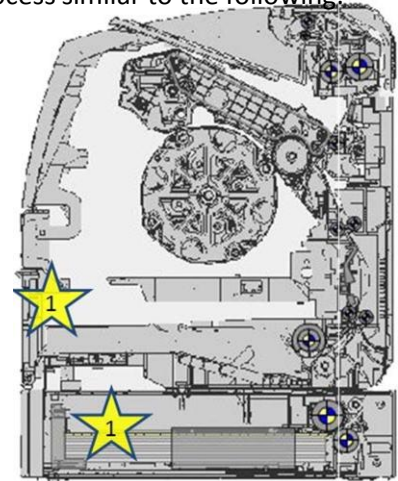
Media Path

Media Path

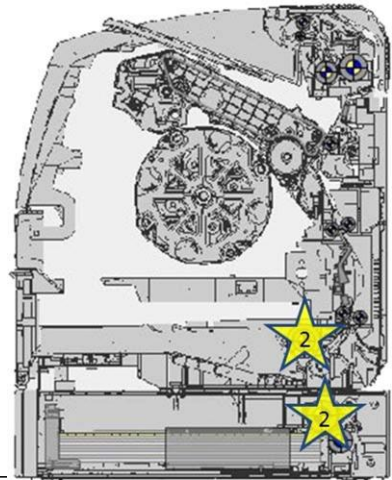
Even though each printer has a unique Media Path, there are many common elements. The graphic illustrates the media path in 3000cn, 3010cn, and 3100cn workgroup color laser printers. Even within the 3000-series, there are differences. For example, the 3110cn uses tandem xerography, and the media path differs to support that printing method. Always check your printer's *Owner's Manual* or *Service Manual* for your printer's specific path and components.

Generically speaking, the media flows through the media path in a process similar to the following:

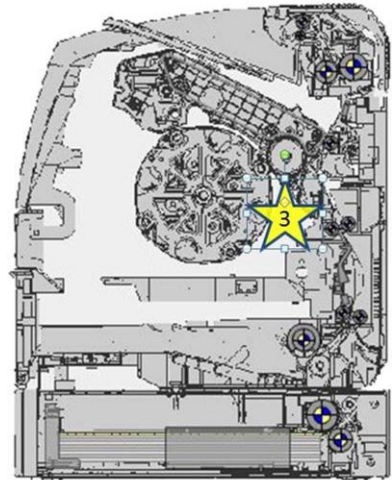
1. The print media starts out in a media tray or Multipurpose Feeder (MPF).



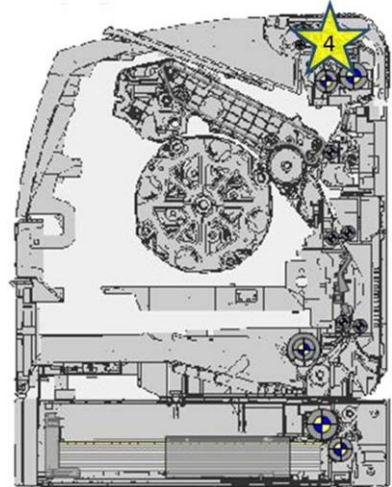
2. A take-up roller feeds one sheet at a time along a designated path.



3. The print media usually makes at least one turn before passing the drum.

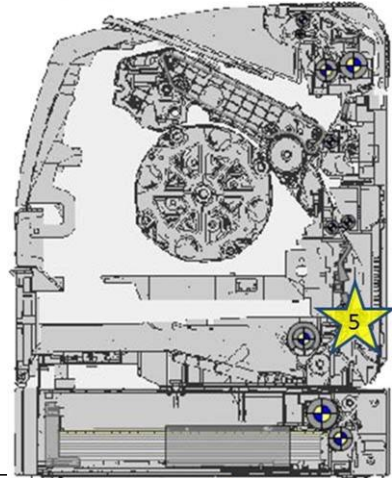


4. The media may make another turn on its way to the fuser.

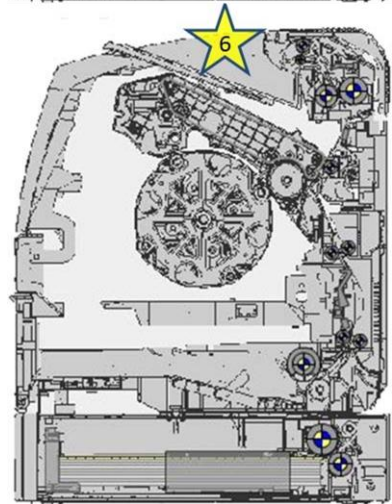


5. A duplex unit may route the print media past the drum and fuser again to print the other side.

Note: The star represents where media re-enters the path after exiting the duplexer. The option duplexer is not shown on this illustration.



6. The print media usually makes one last turn on its way to an exit tray.



A series of rollers or belts feeds the media through the path. Sensors report its progress to the printer's control unit, which controls the motors, rollers, and belts that move the media and the imaging components that print the media.

Media Trays

The media path begins either in a media tray or a multipurpose feeder (MPF). Some printers may have both.

See below to learn more about media trays and sensors.

Standard trays

- Standard trays slide in and out of a bay that may be part of the printer chassis



Multipurpose feeders

- These trays are embedded in the printer chassis and are primarily used for printing non-standard media such as card stock or odd-sized media



Each printer's media trays are designed for its media path and cannot be exchanged with media trays from other types of printers. For example, the 3000-series media trays feed from the rear, but the 5000-series media trays feed from the front.

A sensor in each tray detects the amount of media available for printing. The media sensor can be:

A mechanical drop-down sensor

- A drop-down sensor moves out of the way when you insert the tray, then drops down onto the media.

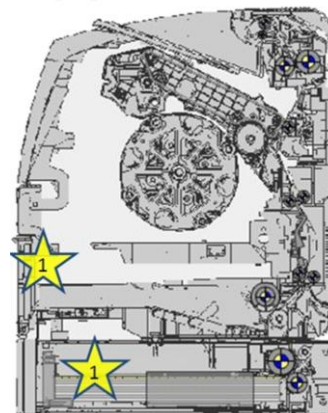
A mechanical switching spring

- A mechanical spring switch may be incorporated into the bottom of the tray. Adding media forces it to its lowest setting.

In either case, the sensor extends as media is consumed. When the tray is empty, the sensor is at its fullest extension.

A defective sensor can cause:

- A false jam if the printer thinks it has media and another sensor reports that the media did not arrive as expected
- A false paper-out error if the sensor cannot detect the presence of media in the tray
- Some printers also have sensors built into the tray to detect the size of the media currently loaded. These sensors report the position of the media length guides.



A take-up or pick roller feeds the media into the path, one sheet at a time. Other tray components work in conjunction with these rollers. See your printer's *Owner's Manual* or *Service Manual* for details.

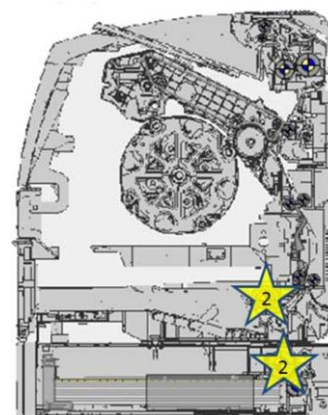
Rollers and Belts

Rollers and belts move the media through the feed path.

Below is more information about the different types of rollers.

Take-up rollers and pick rollers

- Usually located in the media tray or the media bay, take-up rollers pick up a single sheet of media and feed it into the path. Defective or worn feed rollers may:
 - Be unable to pick up any media (false jam)
 - Grab more than one sheet (misfeed)
 - Feed the media askew to the path orientation (misfeed)



Registration rollers

- Rollers or belts that compensate for media that feeds askew to the path. Registration rollers align the leading edge of the media to the path.

Feed rollers

- Located throughout the feed path, these rollers move the media along. Some printers also refer to the take-up rollers as feed rollers because they feed the media into the path.

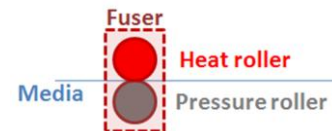
Other rollers

- Other rollers keep the media moving all of the way through the feed path. Some rollers, like the transfer roller, serve double duty. While the transfer roller is a critical part of the imaging engine, it also serves to keep the media moving. The same is true of the pressure and heat rollers in the fuser.
- Some printers have a set of exit rollers that propel the media into the exit tray.
- A sensor may be located near each of these rollers to track the progress of the media through the path.

The Fuser

The last stage of the component of the print process is the fuser. The fuser is comprised of two rollers:

- The heat roller, which supplies the heat that melts the toner.
- The pressure roller, which presses the media tightly against the heat roller to help ensure that the media is evenly heated and moves through the fuser quickly.



Since both of these rollers are part of the fuser assembly, failure of either requires replacing the whole assembly.

When media exits the fuser, it enters either the Duplexer (if applicable) or the exit tray.

The Duplexer

The duplexer enables printing on both sides of the media, a process called duplexing or duplex imaging. The duplexer can be an optional unit (as in the 3000cn), or it can be an integral part of the feed path (as in the 5100cn).

The duplexer:

- Receives media from the fuser



- Transports media to the beginning of the feed path

- Orients the media so that the second side can be printed

The 5220n's main chassis rests on its duplexer.

- Feeds media into the path

For duplexing to work, the duplexer must be properly aligned with the feed path at both the fuser and the entry point.

The 3000-series duplexer attaches to the back of the printer.



The Exit Tray

The exit tray is the final resting place of the printed media. Different printers have different exit tray capacities.

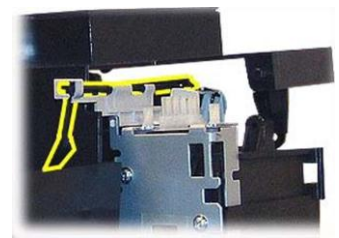
Below is more information about capacity.

A sensor located where the media enters the tray determines if the tray is full. Because of its shape, the output sensor may be called the output flag.

Failure of this sensor may cause:

- A media jam in the fuser
- Media to spill out of the exit tray

Some printers offer an output tray expansion that greatly increases the output capacity of the printer. For example: the 5210n has a default capacity of 250 sheets. But with the optional output expander, its output capacity increases to 650 sheets.



Review

At the client, the print process involves:

- The application
- A page description language
- Printer and network drivers

Applications interact with the operating system, which interacts with the driver to communicate with the printer.

- Users can configure the printer driver with dialog boxes.

The Print command configures settings for the current print job only, but the application may store the settings with the document.

Users can configure the printer driver with dialog boxes.

- Print Properties configures settings for the current session.
- Print Preferences configures default settings when using the printer from the client. Printer defaults are not usually affected.
- Settings from the dialog boxes are applied in a specific hierarchy.

The printer driver uses a page description language to communicate with the printer.

- PDLs describe how a printed page should look to the printer.
- There are many PDLs and each may have more than one version.
- Each PDL the printer supports has its own dialog boxes.

Dell workgroup laser printers can:

- Connect directly to a print server using a USB cable
- Connect to a print server over the network
- Function as their own print server when connected to a network

The electronic, media handling and imaging subsystems work together in the printer to create a printed document.

Xerography is a standardized technology, but specific details may vary among printers.

See below for the stages of the printing process.

Charge

- The charge roller evenly distributes a charge that is discharged (exposed) by the laser to create the latent image.
- Symptoms that the charge roller could express include:
 - Black toner streaks, spots, lines, or background fog that appear several times on letter-sized media
 - Completely black pages

Expose

- The laser exposes parts of the drum, changing the charge so that toner will attach to it.
- The exposed areas of the drum form the latent image.
- A damaged or malfunctioning drum can cause:
 - Black streaks or lines
 - Voids
 - White spots on the black test page
 - Black spots on the blank page quality test
 - Thin solid lines down the page
- A damaged or malfunctioning laser can cause
 - Dropouts

- A solid black line
 - An unfocused image
 - Random background clutter
- Failure of the laser can cause random dropouts or completely blank pages.

Develop

- The developer transfers toner from the toner cartridge to the drum
- When the toner sticks to the exposed parts of the drum, the latent image becomes the developed image
- Low toner can cause:
 - A light print
 - Dropouts
 - White streaks
 - Blank media (when toner is completely exhausted)
- Damage to the developer roll, which may be part of the toner cartridge may cause:
 - Light or faded print
 - A thin line down the length of the media
 - Blank media (when it fails to pick up toner at all)

Transfer

- The transfer roller uses a high-voltage charge to move the toner from the drum to the media.
- A failing transfer roller may cause:
 - A blank or very light document
 - Repeating dropouts

Neutralize

- Neutralization is a two-step process.
 - The erase lamp exposes the surface of the imaging drum and removes excess charge from the drum.
 - A detack saw or other device removes excess charge from the media.

Fuse

- As the media passes between the fuser's heat roller and pressure roller, the toner melts and is pressed into the drum.

Clean

- A cleaning blade removes residual toner, paper dust, and other debris from the drum.

Color printing

- Printers use a subtractive process to create color. The more colors, the darker the image.

Dell printers use two different compositing methods:

- Rotary compositing in early 3000-series printers
- Tandem compositing in the 3110cn

The early 3000-series printers use rotary compositing.

- All four color toner cartridges mount in a cylinder.
- Each cartridge rotates past the imaging drum.
- Color composites on an intermediate belt.
- The developed image transfers from the belt to the media.

Tandem xerography prints all four colors sequentially, using separate charge rollers, drums, and transfer rollers for each color.

5000-series color lasers use a variant form of tandem xerography.

- Each color images onto a separate drum.
- Two intermediary drums (IDT1) composite yellow with black and cyan with magenta.
- Another transfer drum (IDT2) composites the two-color images from the intermediary drums.
- The media picks up the composited image from IDT2.

The media path is the route media follows through the printer.

All Dell workgroup laser printers include at least one of the following:

- A standard media tray
- A multipurpose feeder

A sensor in the media tray detects the presence or absence of media and can cause:

- A false jam if the printer thinks it has media and another sensor reports that the media did not arrive as expected
- A false paper-out error if the sensor cannot detect the presence of media in the tray

Rollers keep the media moving through the feed path. Each printer has a unique set of rollers.

The fuser assembly is comprised of the heat roller and the pressure roller.

Duplexers enable printers to print on both sides of the media.

- The duplexer must be properly aligned with the feed path at both the fuser and the entry point.

The exit tray receives the finished documents. Some printers have multiple output bins.

Networking Workgroup Printers

Learning Objectives

Networkability is a key feature of workgroup laser printers. You can share other laser printers over a network, but workgroup laser printers can handle much heavier workloads than a networked personal laser printer.

Even so, actually connecting a workgroup laser printer to a network is not that different from connecting other networkable printers.

This module provides a high-level overview of networking workgroup laser printers. After completing it, you will be able to:

- Describe the process for connecting a printer over the network
- Recognize the features of the Embedded Web Server (EWS)
- Navigate the EWS
- Describe the differences between the two ColorTrack™ utilities that control color printing on supported printers
- Recognize features of the OpenManage™ Printer Manager

Network Installation

All Dell workgroup laser printers incorporate an Ethernet port and a Web interface. Some printers also offer an optional wireless adapter.

NOTE: Whether you are using a wired or wireless network, this course assumes you know how to manage and troubleshoot your network.

The process for attaching a printer to the network is almost as easy as connecting the network cable:

1. Determine where you want to install the printer.
2. Install any optional hardware such as:
 - Hard drive
 - Memory
 - Multiprotocol card (MPC)
 - Additional trays
3. Determine if you want to use a wired or wireless connection.



4. Connect the printer to the network or directly to a print server.
5. Determine if the printer should use a dynamic or static IP address.
6. Install the drivers on the print server.
7. Create the queue on the print server.

FAX Setup

Although email has become the predominate means of communication, the need to send or receive a fax is still essential.

- Faxes are sent and received over phone lines much like a normal phone call and are not use your internet provider unless you have a special service. Your fax capable printer will need to be connected to your phone line even if you have a broadband connection.
- Make sure you have a telephone cable, telephone service, a fax capable printer and supporting software and a phone jack located close to your printer.
- Make sure to test the phone jack for dial tone prior to configuring your printer for faxing
- From the front panel, select the correct country code to ensure the correct phone transmission for your region then use the associated FAX software package with your printer to setup the remaining features such as number of rings before pickup.
- Remember to send and receive a test fax after setup to ensure the feature is working properly.

Printer Location

Before unpacking the printer, you should have a good place to install it. Here are a few guidelines:

- Find a place that is convenient for your users to access. Retrieving print jobs should not be a chore; otherwise, users may simply forget to pick up their documents.
- Laser printers generate a lot of heat. Avoid enclosures and make sure there is plenty of room for air to flow around all sides of the printer.
- Place the laser printer on a stable surface. Laser printers can be very heavy and can cause bodily injury if they fall on someone.
- Some printer models can be configured with a number of additional trays, making them too high and unsafe for table top use. These may require special furniture or bases.
- Make sure the media trays are easily accessible.
- Keep the exit tray clear of all obstructions.
- Make sure the panels that provide access to the toner cartridges are easy to access.



Problems with this installation include:

- Table not sturdy enough for the weight of the printer
- Installation partially blocks a door, could be knocked over
- Cables not secured and improperly routed
- Tray access blocked by handles

Dusty environment

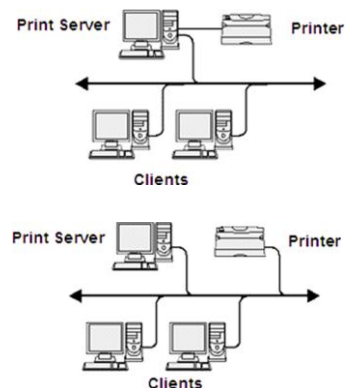
- Make sure the environment is reasonably clean. Excessive dust can cause print defects and block ventilation.

Remote or Direct to the Print Server

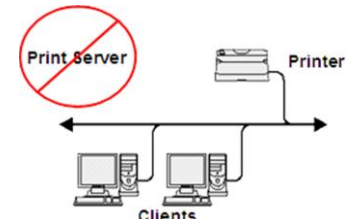
In most cases, the print job gets to a workgroup laser printer over a wired or wireless network.

Different types of network connections are:

- *Connect directly to a print server using a USB or parallel cable.* Local printers connect to a dedicated print server on a network that controls all print job queues releasing the clients for other tasks. Printer location is determined by length of cables, usually within several feet of the print server.
- *Connect to a print server over a wired or wireless network.* Remote printers connect to a network where a dedicated print server controls all job queuing releasing the clients for other tasks. Printers can be placed anywhere on the network.



- *Connect directly to a wired or wireless network and use the printer's internal print server.* Using the printer as its own print server has all of the advantages of a remote connection to a print server and it eliminates the expense of a print server. Each client controls print queue operation; each client has a copy of drivers installed; printers can be placed anywhere on the network.



Dynamic or Static IP

In an enterprise environment, most networked devices use Dynamic Host Control Protocol (DHCP). Dell workgroup laser printers default to DHCP from the factory. In many cases, all you need to do is connect the network cable to the printer and let it run.

But there are a few reasons to use a static IP:

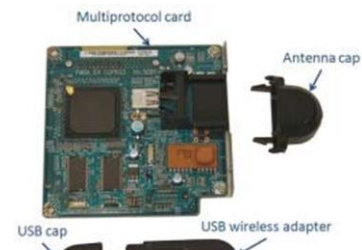
- Drivers configured to look for a specific IP (rather than a host name) may lose the printer if its address changes.
- Static IP addresses don't change when you move the printer. Dynamic IP addresses may change anytime the printer reboots.

Wired or Wireless Networking

All Dell workgroup lasers support a wired Ethernet network, and many also support an optional wireless network adapter. Even printers that do not have wireless support can be connected to a wireless network if an access point is close enough. Just run a cable from the access point to the printer.

Dell offers two wireless solutions for specific printers:

USB Dongle. The 3110cn, 3115cn, and 5110cn printers use a USB dongle installed into the printer's multiprotocol (MPC). The MPC is a separate option for these printers. The MPC provides support for AppleTalk, Linux, and Unix networks.



Internal Card. The 5210 and 5310 printers support a wireless adapter that installs directly into a slot in the printer's interconnect slot. The card supports both ad-hoc and infrastructure 802.11b/g networks.



For more details on installing and configuring these wireless adapters, see the relevant product documentation.

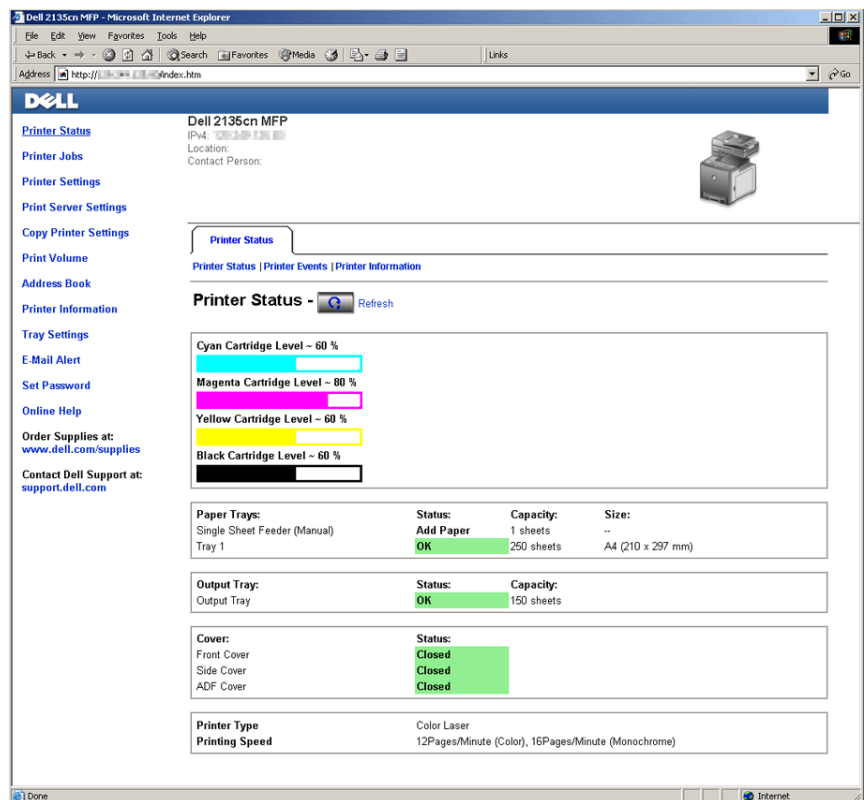
Embedded Web Server

All networkable Dell laser printers incorporate the Dell Printer Configuration Web Tool or Embedded Web Server (EWS). The tool is a Web-based configuration utility built into the printer's firmware. The user interface for the web tool has been fairly consistent across products, taking differences in product features into account.

The Dell Printer Configuration Web Tool is accessible only through the printer's network connection:

1. Open a supported browser on any networked computer.
2. In the browser's Address field, type the IP address of the printer.

When the Configuration Web Tool opens, it provides access to every configuration option that is available through the operator panel. Another graphic shows the level of each toner cartridge. You can access many Web Tool controls through more than one path. Some of the Web Tool menus open submenus of other menu items.



Every Dell workgroup laser printer has an embedded print server to facilitate remote printer management.

Below are descriptions of common menus in the Dell Printer Configuration Web Tool.

Printer Status. Get immediate feedback on printer supply status. When toner is running low, click the Order Supplies link on the first screen to order additional toner cartridges.

Printer Jobs. Lists the jobs currently in the queue of those already completed.

Printer Settings. Change printer settings, view the operator panel remotely, and update the print server firmware.

Printer Server Settings. View and change current network settings. You must have the printer's Administrator password to make any changes in this section.

Copy Printer Settings. Quickly clone the printer's settings to another printer or printers on the network just by typing each printer's IP address. You must be a network administrator to use this feature.

Printer Information. Keep track of printing trends, such as paper usage and types of jobs being printed.

Tray Settings. View and adjust tray settings for the printer.

Printer Information. Get the information you need for service calls, inventory reports, or the status of current memory and engine code levels.

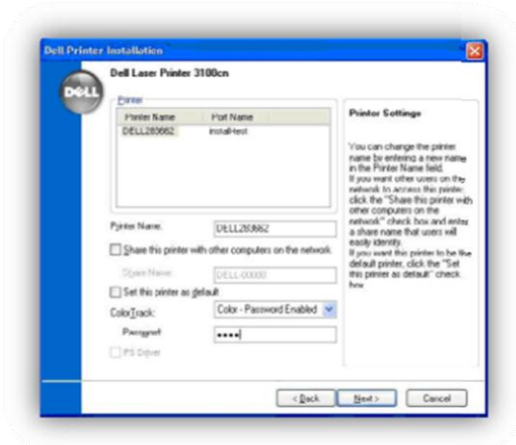
E-mail Alert. Receive an e-mail when the printer needs supplies or intervention. For specific instruction on using this feature, see the printer's *Owner's Manual* or *Service Manual*.

Set Password. Lock the Web Tool with a password so other users do not inadvertently change the printer settings you have selected. You must have the printer's Administrator password to make any changes in this section.

ColorTrack™

Printing in color is much more expensive than printing the same document in monochrome. At the same time, most users find color documents to be much more appealing than monochrome documents. To help administrators control the costs of color printing, Dell implemented ColorTrack™, a driver-based application that enables system administrators to enable or disable color printing at a group or user level.

With ColorTrack enabled, users who are authorized



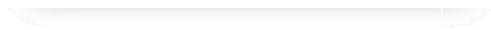
to print in color can:

- Toggle between monochrome (default) and color printing
- Enter Toner Saver and Draft print modes

Network administrators can:

- Control rights to access color printing
- Assign a color or monochrome driver to each printer

For more information about the original, driver-based ColorTrack system, see [Explanation of the ColorTrack Feature for the Dell™ Color Laser Printers](#), available on support.dell.com.



ColorTrack2™

ColorTrack2 is a printer-based utility that allows an administrator to control access to color printing on supported printers.

ColorTrack2 offers more robust management of color printing than its predecessor, ColorTrack, which is a driver-based utility. ColorTrack2 must be enabled and configured via the EWS, and the driver on the client computer must be configured to work properly.

For specific instructions on using ColorTrack2, see the [Explanation of the ColorTrack2 Feature for the Dell™ 3110cn, 3115cn and 5110cn Color Laser Printers](#) on

support.dell.com. With ColorTrack2 you can:

- Change access via the EWS.
- Change access dynamically in real time.
- Configure a combination of up to 50 user or group accounts for color management.
- Set maximum monochrome or color print volumes per account.
- Assign a password to each group or account.

ColorTrack2 has the following limitations:

- ColorTrack2 can only be configured using the EWS and cannot be modified from the printer's operator panel.
- ColorTrack(1) monochrome-only or password-protected color drivers installed on the client computer override ColorTrack2 management.

- Administrators cannot copy or import user lists.
- ColorTrack2 does not support LDAP and Active Directory.
- Time-based printing limits (e.g., 400 color pages per month) cannot be set.

There are three basic steps needed to configure ColorTrack2:

- Enable the ColorTrack2 feature.
- Add a user to ColorTrack2.
- Configure the printer driver for ColorTrack2.

Dell OpenManage™ Printer Manager

The Dell OpenManage™ Printer Manager (OMPM) provides an automated repertoire of management and report generation tools that enable companies to recognize and optimize their Total Cost of Printing (TCOP) throughout the useful life of the printer. TCOP accounts for:

- Printer acquisition
- Consumable usage
- Servicing

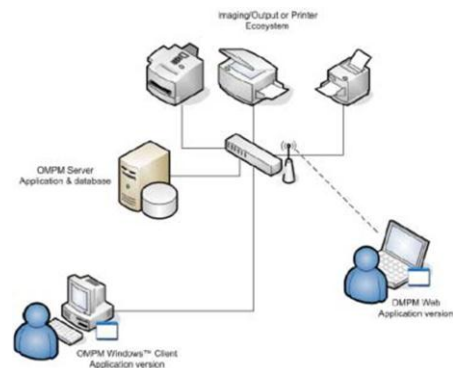
Recommended for fleets of 50 or more printers, OMPM is a server-based application and database that:

- Monitors Dell and non-Dell printers on the network
- Consolidates the data in a single location
- Provides configurable reports and alerts
- Facilitates communication with dell.com to reorder consumables

Administrators can interact with the server application using either:

- A Windows™ client application
- A browser

You can download OMPM from support.dell.com.



Review

All Dell workgroup laser printers support an Ethernet connection. Many also offer an optional

wireless adapter.

Laser printers require a stable, well-ventilated location.

- It should be easy for users to retrieve print jobs and replenish media.
- Obstructions to the exit tray can cause jams or otherwise damage print

jobs. Print server options include:

- Connect directly to a print server using a USB or parallel cable
- Connect to a print server over a wired or wireless network
- Connect directly to a wired or wireless network and use the printer's internal print server

Dell workgroup laser printers default to DHCP, but you can set a static IP if needed.

The 3110cn, 3115cn, and 5110cn printers use a USB dongle installed into the printer's multiprotocol card (MPC). The MPC is a separate option in these printers.

The 5210 and 5310 printers support a wireless adapter that installs directly into a slot in the printers interconnect slot. The card supports both ad-hoc and infrastructure 802.11b/g networks.

All Dell workgroup laser printers feature a Web server (EWS) embedded in their firmware.

- The EWS enables you to monitor and manage the printer remotely.
- You can accomplish any task through the EWS that you can accomplish through the printer's menu system.

ColorTrack was originally implemented in the driver and suffered the limitations of a driver-based solution.

Because ColorTrack2 resides on the printer, it offers much tighter control over color printing than the original version.

OpenManage™ Printer Manager (OMPM) is recommended for managing large printer fleets. It is a server-based application and database that:

- Monitors Dell and non-Dell printers on the network
- Consolidates the data in a single location
- Provides configurable reports and alerts
- Facilitates communication with dell.com to reorder consumables

Troubleshooting: Overview

Learning Objectives

Dell Support (support.dell.com) is your primary troubleshooting tool. But you can use support.dell.com more effectively with a little background information. This module provides context for troubleshooting printers.

After completing this module, you will be able to:

- Find resources to help you resolve printer issues
- Describe a systematic approach to diagnosing and resolving printer issues
- Recognize the characteristics of printer diagnostic modes
- Correlate symptoms with the components that are likely to cause them



Dell Support

Dell Support provides great troubleshooting and support resources online at support.dell.com. On support.dell.com, you can find:

- Drivers and downloads for your printer or other Dell product
- Technical support and product help
- Order status information
- Warranty information
- Customer service



Two of the most important tools are the Dell Forums and the Dell Solutions Network (DSN).

- In the forums, you can talk with other Dell customers to learn how they have resolved issues

- with their printers.
- DSN is a database of:
 - Product information
 - Technical support articles
 - Troubleshooting decision trees

Dell Support: Decision Trees and Journal IDs

The decision trees provide step-by-step procedures for resolving technical issues.

Along with the decision trees, DSN provides a journal ID. The journal ID is the key to a record of the troubleshooting steps you performed. If you need to contact technical support, the journal ID enables support agents to review your troubleshooting efforts and find a solution more quickly.

NOTE: Always record your journal ID when using the decision trees. If you are unable to resolve the process on your own and need to contact technical support, the journal ID streamlines the process.



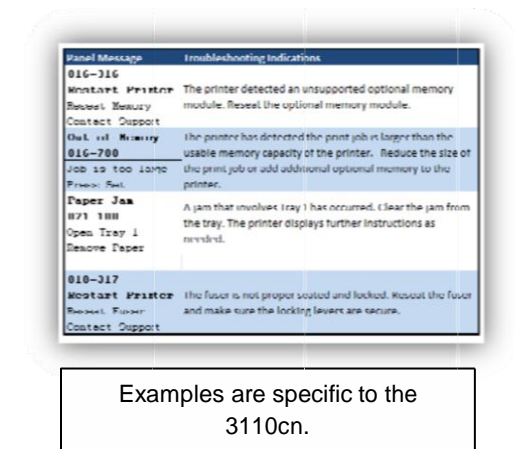
Error Messages

If an error condition arises in a printer, it displays an error message in two places:

- The Embedded Web Server (EWS), which you can access with a Web browser and the printer's IP address
- The LCD on the printer's operator panel

The error messages have a four-line format, even though the operator panel can display only two lines at a time. The display toggles the message two lines at a time.

Each error message has three parts:



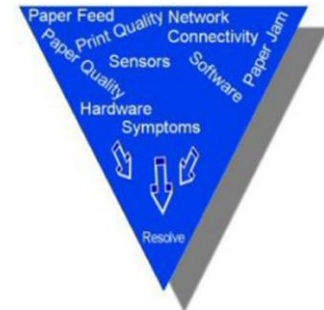
Examples are specific to the 3110cn.

1. A six-digit code that references the specific error condition detected. Look up the code in your printer's *Owner's Manual* or *Service Manual* for troubleshooting specifics.
 - Example: 010-354
2. A text description of the code. This description is high-level, and the same text may be used for multiple codes.
 - Example: Restart Printer
3. Two lines of explanatory text. The explanatory text provides basic instructions for resolving the current error.
 - Example: Contact Support If message returns

Symptom-Based Troubleshooting

Symptom-Based Troubleshooting

Troubleshooting laser printer products can be a complicated undertaking. Printers are primarily mechanical devices. It is helpful to have a basic understanding of the process and how each element within the printer contributes to the final product. This section presents a basic strategy for troubleshooting Dell workgroup laser printers.



You can apply the following troubleshooting guidelines to almost any product or situation.

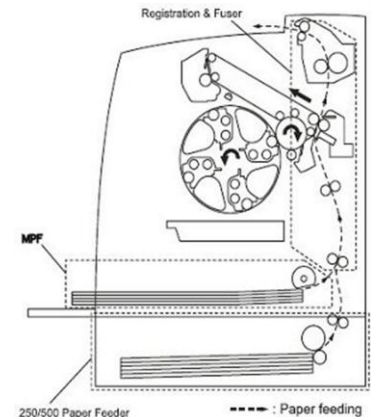
1. Gather as much information about the issue as you can.
2. Categorize the symptoms to identify the possible causes.
3. Test the possible causes to identify the root cause through a process of elimination.

Gathering Information

To resolve an issue, you must first gather as much information as possible. The more information you have, the easier it is to get a clearer picture of the nature of the issue.

You can use simple questions to help identify to the actual issue:

- Was this printer just recently installed?
- Has it ever functioned correctly?
- When did the printer start having the problem?
- When was the printer last working correctly?
- What has changed?
 - Has the printer been moved?
 - Is it using the same network connection?
- Are the appropriate drivers installed on the PC that is having problems accessing the printer?
- What error messages, if any, appear on the LCD when you attempt to print?
- What application is the user printing from? Does the issue happen with other applications?
- Has the user tried cycling power on the printer?
- What type of media is being used?



You will think of many more questions, depending on the initial problem description and the answers you get. Each troubleshooting situation is unique.

Although the initial problem description is a good starting place, remember that the printer users you support may not be able to describe a problem accurately.

For example, they may indicate that the printer is not picking up paper from a fully-loaded 250-sheet tray. But when you ask about the error message on the printer, they tell you it says, "Load MPF Tray." The initial description would lead you to think that the media tray was at fault when the error message tells you something completely different.

What could cause the error "Load MPF Tray"?

- The user's application is telling the printer to use the MPF as the media input.
- The printer has been sent to default to the MPF.

Categorizing Symptoms

Most printing symptoms fall into one or more of the following categories:

Jams and Misfeeds: Jams and misfeeds are failures of the media to feed properly along the complete feed path of the printer and out again. A failure to complete the paper path can result from a variety of failures and is often the most difficult of issues to resolve.

Jams and misfeeds can result from:

- A timing or cleaning issue with a sensor
- An obstruction in the feed path
- A failure of the system board to properly interpret or time sensor input
- Dirty or damaged rollers
- Poor media quality
- Failure of a motor that would normally turn the rollers to feed the paper through the path

A jam is one, or a combination of, the following conditions:

- Paper is present where it should **NOT** be.
 - Paper is **NOT** present where it should be.



NOTE: When performing service on any Dell laser printer, always clean and inspect all paper feed rollers as a preventative maintenance step to avoid unnecessary paper jam and feed issues due to debris buildup on the rollers. Perform this cleaning procedure on the base tray feed (pick) rollers, as well as on the feed (pick) rollers for any additional trays.

Media Quality: Paper quality is often overlooked as the possible cause of printing issues. It accounts for the largest portion of printing issues that could be classified as "customer avoidable," especially jams and misfeeds.

Media quality issues include using media that is:

- Inappropriate for the printer

- Designed for ink printers
- Too heavy (card stock) or too light (rice paper)
- Improperly stored (excessive humidity)
- Damaged, folded, or crumpled
- Cupped
- Cross grained

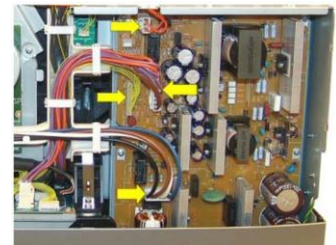
Network Connectivity: This course assumes you are familiar with networking in general and your network in particular. Failures of the printer's network hardware are very rare, but you would troubleshoot the printer's network adapters just as you would troubleshoot those in a desktop or notebook system.

POST: POST issues are those caused by a failure of the printer to complete its firmware "self-test" to reach a "Ready Print" state. POST failures usually result from failure of one of the main components of the engine assembly, including: the system board and power supplies.

A faulty power source can create the illusion or misperception of a power issue with the printer. Eliminating power concerns early on can eliminate any confusion between power and POST issues.

Power: Power issues result from a failure of the printer to obtain or use electricity. Power issues can result from:

- External electrical connections
- Low Voltage Power Supply (LVPS)
- High Voltage Power Supply (HVPS)



When troubleshooting power issues, check:

- The power source
- The power cable and connections
- Internal power connections

Print Quality: Most people would define a quality print job as one that meets their expectations. As technicians, we must add "according to the printer's specifications." User perceptions are a major driver of "print quality issues."

Actual print quality issues result from:

- Failed or contaminated charge rollers
- Scratches in xerographic drum surfaces
- Poor quality or inappropriate media
- Contaminants adhered to the fuser heat roller
- Failing or expended toner cartridges

Software: Software configuration accounts for almost half of support laser printer call volume in Dell call centers.

Software is a broad term used to describe a variety of elements, including:

- The operating system environment
- Drivers
- Firmware
- Applications
- Printer communication languages such as:
- Print Command Language (PCL)
- PostScript

Symptoms of improper printer performance do not necessarily mean that there is an actual hardware failure. Many issues can be resolved by configuring software applications, drivers, and firmware.

Printer Diagnostic Modes

Printer Diagnostic Modes

With printers, there is no separate diagnostic utility to run. All printer diagnostics are built into the printer firmware. Dell workgroup laser printers have two diagnostic modes.

- **Customer mode:** As the name implies, Customer mode is accessible to end users, and they should be encouraged to use it to troubleshoot and resolve printer issues whenever possible.
- **Developer/CE mode:** The Developer/CE mode is reserved for use by qualified and trained service provider technicians (CE = Customer Engineer). End users should be discouraged from using this mode. Many internal printer settings can be changed adversely affecting printer operation and print quality.

For instructions on entering and using these diagnostic modes, see your printer's *Owner's Manual* or *Service Manual* or the Dell Solution Network (DSN), a database of information and troubleshooting procedures accessible through support.dell.com.

Customer Mode: As the name implies, Customer mode is accessible to end users, and they should be encouraged to use it to troubleshoot and resolve printer issues whenever possible.

Developer/CE Mode: The Developer/CE mode is reserved for use by qualified and trained service provider technicians (CE = Customer Engineer). End users should be discouraged from using this mode. Many internal printer settings can be changed, adversely affecting printer operation and print quality.

Digital Input/Output Test

Dell workgroup laser printer feature a series of tests built into their firmware. Each test checks the functionality of a specific sensor or component.

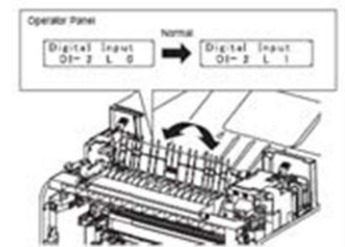
These tests fall into two categories:

- Digital input (DI) tests (sensors)
- Digital output (DO) tests (sensors, motors, and other components)

For example on the 3110cn, DI-2 tests the exit sensor. DO-0, DO-1, DO-2, and DO-3 test various functions of the printer's main motor.

You can access the tests through the printer's operator panel, which also displays the results of the test. To run a test, set the printer to Diagnostic mode. You may also need to physically manipulate the component you are testing. For example, to test the exit sensor, you must raise and lower the fuser exit guide plate. With each manipulation, the LCD should display the change.

WARNING: Be very careful when manipulating the printer's internal components. Some, such as the fuser, are very hot. Others, such as the charge roller, operate at high voltages. Personal injury or death can result from touching these components without following all of the safety precautions spelled out in the printer's *Owner's Manual* and *Service Manual*.



Manual Feed Test

The manual feed tests are a subset of the Digital Output tests. These tests determine if all the components of the media path are functioning correctly. To run the tests, all path components must be installed, and the front covers must be closed.

Because these tests run with no sensor interaction, the media feeds end-to-end with no gap between pages. So, what happens if a jam occurs when running the manual feed tests?

- You must be prepared to stop the test by turning off the printer if necessary.
- "No sensor interaction" means that the printer does not know a jam has occurred. It continues to try to feed media through the jam until you stop it.

Jams and Misfeeds

Jams and Misfeeds

Misfeeds occur when the media fails to enter the feed path correctly. Misfeeds occur when:

- More than one sheet enters the path at the same time
- Media enters the path at an angle

Misfeeds often cause jams—failures of the media to traverse the full length of the feed path. Jams occur when a sensor indicates that media:

- Is present at a place where it should not be
- Is not present at a place where it should be

When a sensor reports a jam, the printer stops feeding media through the path to:

- Avoid wasting media and consumables when an error condition already exists
- Prevent damage to the printer

Most of the time, jams do not recur once they are cleared. For specific information on clearing jams, see your printer's *Owner's Manual* or *Service Manual*. Instructions for clearing the jam may also appear on the printer's LCD.

Causes of Misfeeds

Common causes of misfeeds include:

Improperly loaded media

When loading media:

- Make sure the media is loaded in an appropriate tray.
- Make sure that the media guides are positioned correctly. If they are:
 - Too tight, the media cups and multiple sheets may feed simultaneously.
 - Too loose, the media may enter the feed path to askew for the registration rollers to correct.

Media

Make sure the media:

- Complies with the printer's media guidelines
- Is undamaged and lays flat in the tray
- Is dry

Printer or print driver settings

Make sure all settings are appropriate for the media you are using and the outcome you want.

Worn or dirty take-up rollers

Worn or dirty rollers may not be able to feed media into path correctly. They may fail to pick up the media at all, or they may feed more than one sheet at a time. They twist the media as it enters the path, causing a failure farther into the path.



NOTE: Always clean and inspect all feed rollers as a preventative maintenance step whenever you perform service on Dell laser printers. Keeping the rollers and the interior of the printer clean can prevent jams misfeeds caused by debris buildup on the rollers. Perform this cleaning procedure on the base tray feed (pick) rollers, and on the feed rollers for any additional trays.

Causes of Jams

Anything that causes a misfeed may also cause a jam.

Media

Inappropriate media is a common cause of jams and misfeeds. Inappropriate media can be:

- Too light (rice paper)
- Too heavy (poster board)
- Too small (post cards)
- Too large
- Designed for ink printers
- Designed for other applications (velum)

Motors

Motors cannot move the media through the path when they:

- Have failed
- Are failing intermittently
- Are not getting power

If media stops anywhere in the path where a sensor cannot detect it, the next sheet may jam into the motionless media. This process continues until the media backs up far enough along the path to trigger a jam sensor.

Failed motors usually generate a POST failure code, but intermittent problems may not be detected until a jam occurs.

Printer or print driver settings

The settings on the printer and the settings in the printer driver must match.

For example: a user wants to print a legal-sized document and loads legal media in the MPF. The application knows it is printing a legal document but doesn't know where the legal-sized media is loaded. If the user does not specify printing to the MPF, the application and driver try to print to the default tray, usually tray 1. This situation results in a "Load Legal Tray 1" message on the printer. Users often get frustrated, thinking they have loaded the media and set the printer driver correctly.

Sensors

Sensors detect the presence or absence of media. The printer's computational unit interprets this data to determine if a jam has occurred.

If a sensor consistently reports a jam where none exists or if it fails a diagnostic test, clean the sensor and the interior of the printer. Accumulated toner or paper dust may cause the sensor to generate false signals. Then try to print or run the diagnostic again.

Toner

Laser printers all experience some toner leakage. Accumulated toner can:

- Adhere the media to rollers or cause rollers to fail to grab the media
- Block the laser
- Cause sensors to generate false signals
- Land on media as it progresses through the path, causing a speckled background

Cleaning a laser printer should be a part of your routine maintenance schedule.

Worn or dirty rollers

Worn or dirty rollers may not be able to move media through the feed path efficiently enough to prevent jams.



NOTE: Always clean and inspect all feed rollers as a preventative maintenance step whenever you perform service on Dell laser printers. Keeping the rollers and the interior of the printer clean can prevent jams misfeeds caused by debris buildup on the rollers. Clean the feed rollers throughout the path.

Troubleshooting Jams

When paper is jammed in the printer, your troubleshooting approach should take the condition of the jammed media into consideration.

The paper is physically damaged.

The paper may have been damaged before it entered the path, or an obstruction in the path may have damaged it.

Check the remaining media in the tray and remove any media that is damaged:

- Folded
- Cupped
- Torn



NOTE: Drilled or perforated forms may behave the same as torn or folded media in the feed

path.

- Check for obstructions in the area indicated by the jam message.
- Check for obstructions in other locations which may have damaged the paper and caused it to eventually jam.

Wipe clean the inner surfaces of any involved sensor with a cloth or swab to remove any toner buildup and debris. Then perform a test of the sensor using the proper diagnostic test for that printer. Always check your printer's *Owner's Manual* or *Service Manual* for the correct procedures.

The paper is not physically damaged

The media did not reach a sensor on schedule or was present when it should have exited the sensor's range.

- Multiple feeds can cause the media to appear to be too long. Clear the jam and retry the job.
- The media did not reach a sensor when it should have.
 - A logic error on the controller can cause this problem.
 - A worn feed roller or failed feed roller engine may not advance the media fast enough.

To troubleshoot sensor-related errors:

- Clear the jam and run the diagnostics.
- Check the secondary codes in the Error Messages section of the printer's *Owner's Manual* or *Service Manual*.

Tips for Clearing Jams and Misfeeds

Identify Jam Location: When looking for the jam location, remember that the sensor indicated in the error code only detected that a jam had occurred. The source of the jam may be before or after the sensor in the feed path.

Clear Jam Completely: When clearing jams, be sure to clear the length of the feed path. Jams can result from debris in the path, and they can generate more debris, especially if they damage the media.

Check Media: Don't forget to check the media! Most jams are caused by inappropriate, damaged, or improperly stored media.

Image Quality Issues

Image Quality Issues

Image quality issues result from a problem in the print engine or the perception of such. Common image quality issues include:

Perception and expectations

The user's expectations concerning print quality can cause false issues if not addressed through education about the product's capabilities and limitations.

For example, if a user attempts to print photos on a color laser printer using glossy ink-jet paper, the result will not be successful. The user should be told that this type of printing is not what the printer was designed to do. Briefly explaining that color laser printers are designed for color business graphics printing, not reproduction of photographs usually corrects this expectation.

If the customer is using ink-jet glossy paper, you may want to explain the difference between ink-jet and laser paper. These different types of paper are specifically designed according to the print process of the intended printing process and will never achieve the desired results on a printer that is not designed to use them. This result is the reason papers are labeled for a specific types of printer.

Configuration

Configuration is a major cause of print quality false issues.

Users may expect a high-quality print and not achieve the desired quality simply because the printer's color quality setting is factory defaulted to a setting of medium- or low-quality color to conserve toner.

This misperception can be corrected quickly (and in most cases permanently) by educating users about the adjustments they can make to their printer to achieve a more desirable result.

Media quality

Media quality can drastically affect the quality of the finished print.

If the media surface is too smooth, such as ink-jet glossy photo paper, the toner does not fuse correctly to the media. On the other hand, if the paper surface is too rough, the toner does not fuse properly into the surface either. The problems with fusing cause deletions or deletion spots. Be sure to check that the proper specification paper is installed in the printer when addressing any print quality issue. If possible, install paper from a freshly opened ream as a first step in troubleshooting.

Contamination

Contamination of various components along the paper path can display as print quality defects.

Often this problem can be resolved by cleaning the rollers along the path such as feed rollers, transfer roll, charge roll, and PC drum. When added defects such as smears, vertical lines, or spots appear on print, always check the fuser hot roller for contamination as a first step. When labels or other papers that contain adhesive backing are fed through the paper path, the adhesive has a tendency to bleed out onto the fuser hot roll during the fuse process. This causes print quality defects such as spotting, lines, and smearing.

Device failure

Failure of a specific device such as a motor can lead to print quality defects as well.

For instance, failure of the yellow developer motor on the 5100cn causes the yellow toner not to dispense properly, ending in a print or prints devoid of yellow color.

Troubleshooting Print Quality Issues

Troubleshooting suggestions for common image quality issues are listed below. These suggestions are not a replacement for using the troubleshooting steps available on support.dell.com. The specific diagnoses and suggestions are valid for the 3110cn.

Blank pages

- Make sure the packaging material is removed from the toner cartridges.
- Check the toner cartridges to make sure they are installed correctly.
- The toner cartridges may be low or need to be replaced. Confirm the amount of toner in each and replace it with a new one if necessary.



Completely or partially black output

- Check the print cartridges to make sure they are installed correctly.
- Enable the **Change All Colors to Black Text Smoothing** option on the **Advanced** tab in the Printer Properties dialog box.



Faded image on left and right sides of the page

- This problem occurs when the printer is operating in a location where relative humidity reaches 85% or more. Adjust the humidity or relocate the printer to an appropriate environment.
- Make sure paper being used is stored in the same location as the printer. Users often store paper in a separate location with a very different temperature and humidity level. If so, they should bring replacement paper to the printer location and allow at least 24 hours for the humidity in the paper to adjust before using it.



Horizontal streaks

- Use the "ContaminationChk" test pages to separate the individual colors and determine which cartridge needs replaced.
- Determine the toner cartridge which exhibits the defect, and then swap with a known good cartridge if possible.
- Replace the defective cartridge.



Horizontal deletions

- This type of deletion points to a defect in one of the bias transfer rollers. Print the "ContaminationChk" pages in Customer Diagnostics mode and determine if the defect can be isolated to a single color.
- All four bias transfer rollers are contained within the transfer belt assembly. Use the "ContaminationChk" pages to determine the distance between the defect repetitions, and then use the roller diameter test sheet to verify that the distance matches the diameter of a bias transfer roller.
- Once you have verified that the defect is being caused by a bias transfer roller, replace the transfer belt.
- This defect symptom can also be caused by contaminated HVPS-to-transfer belt contacts. Locate the four metal power contacts on the top-left side of the transfer belt assembly and clean them with a lint-free cloth.

Incomplete fusing

- If you are printing on an uneven print surface, change the paper type settings in the **Tray Settings** menu.
- Verify that the print media is within the printer specifications.
- Substitute a new ream of paper and try printing again.
- If the previous steps do not resolve the issue, the fuser is not working properly. Replace the fuser



Light print

- The print cartridges may be low or need to be replaced. Confirm the amount of toner in each print cartridge and replace it with a new one if necessary.
- Deselect the **Toner Saving Mode** check box on the **Advanced** tab in the printer driver.
- If you are printing on an uneven print surface, change the paper type settings in the **Tray Settings** menu.
- Verify that the correct print media is being used. Try different print media if it is available.



Random deletions

- Check for contamination on the transfer belt assembly.
- Swap the installed paper with different paper that falls within acceptable specifications.
- Swap the transfer belt assembly if a known good transfer belt assembly is available.
- Replace the transfer belt if the issue follows the belt.



Random spots

- Use the "ContaminationChk" test pages to separate the individual colors and determine which cartridge needs to be replaced.
- Determine the toner cartridge which exhibits the defect, and then swap with a known good cartridge if possible.
- Replace the defective cartridge.



Vertical deletions

- A developer roll or imaging drum is damaged.
- Use the "ContaminationChk" test pages to separate the individual colors and determine which cartridge needs to be replaced.



Vertical streaks

- The toner cartridges may be low or need to be replaced. Confirm the amount of toner in each cartridge and replace it with a new one if necessary.
- If you are using pre-printed forms, make sure the media can withstand temperatures of 0° to 35° C.



Noise Issues

Like all mechanical devices, Dell laser printers make noise when they work. Sometimes users have unrealistic expectations about the kinds of noise it should or should not make.

Noise issues come from any part that moves, and there are many moving parts:

- Motors, including fans
- Toner cartridges
- Rollers and roller feed assemblies
- Gear assemblies

The best course of action is to try to isolate the specific part causing the noise issue. Try reseating components or swapping with known good parts from another printer if possible.

Incompatible media can cause the printer to work harder than it was designed to work, in which case the excessive noise is indirectly caused by the media being used. Make sure the media in the printer falls within the printer's media guidelines. You can find the media guidelines in the *Owner's Manual*.

Media

The quality of paper used in the digital printing process can greatly affect the quality of the finished print produced and the frequency of paper jams. It can also affect various other elements of the printing process. For best results with the fewest problems, always use a high quality paper with no filler or additives. Choose media that is specifically designed for laser printers and the intended print job.

Media characteristics that can affect print quality and cause jams include:

- Curl
- Fiber content
- Grain direction
- Moisture content
- Paper dust and contaminants
- Recycled paper
- Smoothness
- Weight and size

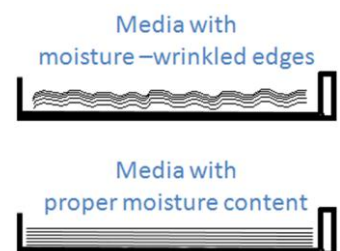
The following pages discuss each of these characteristics.

In general, always follow the media guidelines specified in your printer's *Owner's Manual*.

Curl

Curl is the tendency of paper to curve at its edges. If curl is excessive, it can cause feed problems. Curl can result from:

- Excessive moisture in the paper
 - A humid environment
 - Storing the paper unwrapped, even in the tray
- The heat used in the fusing process



Some manufacturers offer paper that has been processed to prevent excessive curl. Papers with "curl control" are preferable, and are usually marked as such in the specifications section of the paper package label.

To avoid curl:

- Store media in a flat, dry location.
- Allow media to acclimatize to the location before using it.

Fiber Content

Paper designed for laser printers is usually made from 100% chemically-pulped wood. This content provides the paper with a high degree of stability, resulting in fewer feed problems and better print quality.

Paper containing fibers such as cotton possesses characteristics that may make it more esthetically pleasing but can result in degraded paper handling. The amount of cotton a paper contains is often described as the percentage of rag. So 20% rag paper consists of 20% cotton.

Grain Direction

Grain refers to the alignment of the paper fibers in a sheet of paper. Paper is either:

- Long grain — the fibers orient along the length of the page.
- Short grain — the fibers orient along the width of the sheet.

The type of media you should use may depend on the type of tray and the application. For example, the *Owner's Manual* of the 3110cn recommends:

Long grain
for:

- 60 to 176 g/m² (16 to 47 lb. bond) paper
- Media loaded in standard trays

Short grain for:

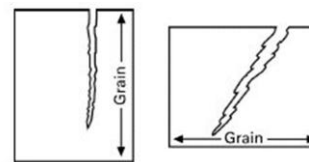
- Papers heavier than 176 g/m² (47 lb. bond)
- Media loaded in the multipurpose feeder

Determine Grain Direction

Grain direction is usually indicated on the packaging. If not, or if the packaging is not available, you can determine the grain direction with the following tests.

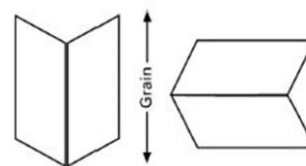
Tear test

Tear a sample sheet of paper partially lengthwise, and then partially width-wise. Paper tends to tear in a straighter and more uniform fashion along the grain.



Fold test

Fold a sample sheet of paper lengthwise, and then width-wise. Paper folds made with the grain tend to appear smoother than folds made across the grain.



Moisture Content

The amount of moisture in the media affects both print quality and the ability of the printer to feed the media properly. Excessive moisture can cause:

- Curl, which is discussed earlier in this topic
- Dropouts that arise from the moisture interfering with change in the transfer process
- Jams that result from media tearing because moisture has weakened it
- Smears that arise from the moisture preventing the media from heating fully in the fusing process

To prevent moisture-related issues:

- Store media in a climate-controlled location.
- Leave media in its original wrapper until you are ready to use it. This limits the exposure of the media to moisture changes that can degrade its performance.
- When moving media from a storage environment to the printer, allow 24 hours for the media to adjust to the humidity of the new environment before using it.

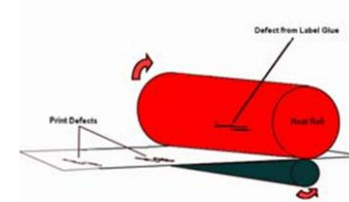
Paper Dust and Contaminants

It is extremely important not to sacrifice quality for cost when choosing paper for high volume printing. Paper that contains or generates excessive paper dust or contaminants can cause feed and jam issues. The issues can be intermittent and very hard to diagnose.

Other contaminants include adhesive coating residue and loose fibers from paper with poor cut quality or improper packaging.

Recycled Paper

It is very important to base your decision to purchase recycled paper on the specifications instead of the price. Huge differences in the quality of recycled papers exist. What may seem like a cost savings at time of purchase may end up costing countless hours of lost productivity and printer down time.



Recycled paper made using a less expensive chemical cleaning process may cost less to purchase than papers that go through a more thorough cleaning. Unfortunately, the less expensive process may not remove contaminants such as glue adhesive. These contaminants can cause feed and print quality issues.

A good example of this is adhesive coating used for sheets of labels. This adhesive can leave a residue if it gets pressed out during the fusing process. It can and will stick to the fuser heat roll, resulting in print defects on the back side of prints. Buildup of contaminants is one of the leading causes of service calls.

Smoothness

The degree of smoothness of media directly affects print

quality. If the media is too rough:

- The toner does not fuse to the paper correctly, resulting in poor print quality.
- The toner usually fuses well to the media peaks, but inconsistently to the

valleys. If the media is too smooth:

- Toner may not be able to fuse to the media, resulting in dropouts or smears.
- Feed problems may result.
- Smoothness must be between 100 and 400 Sheffield units (SUs), but smoothness between 100 and 250 SUs produces the best print quality.

Weight and Size

Inappropriate media weight and size can lead to jams and misfeeds. You can use the weights mentioned in this topic as a rule of thumb. Always check your printer's *Owner's Manual* for specifics.

See below for some general considerations.

Best Performance: Most Dell workgroup laser printers automatically feed media between 60 to 176

g/m² (16 to 47 lb. bond). For best performance, use 75 g/m² (20 lb. bond) grain long paper.

Light Stock: Media lighter than 60 g/m² (16 lb.) might not be stiff enough to feed properly:

- Jams could result from the media tearing or crumpling in the path.
- Misfeeds could result from the printer pickup up multiple sheets.

Heavy Stock: Media heavier than 176 g/m² might be too heavy to negotiate the bends and turns in the media path.

- Some printers require that cardstock load in the multi-purpose feeder (MPF).

Standard and Special Sizes: Most media trays can accept standard letter and A4 media.

- Legal size and other longer media may require a special tray or MPF.
- Envelopes should always be loaded in the MPF.
- If you want to print on materials narrower than 182 x 257 mm (7.2" x 10.12"), the basis weight must be greater than or equal to 90 g/m² (24 lb. bond).

Review

Review the summary of this topic before taking the self-check to see how well you mastered the topic.

Support.dell.com provides:

- Drivers and downloads
- Technical support and product information
- Dell Forums
- Dell Solutions Network (DSN)

When using the decision trees, DSN records the troubleshooting steps you take. A journal ID lets technical support agents review your troubleshooting and find a solution more quickly.

Error messages on Dell workgroup laser printers have a four-line format, even though the LCD can only display two lines at a time.

- The first or second line contains:
 - A six-digit code
 - A brief description
- The third and fourth lines contain a longer set of explanatory text.

You can troubleshoot printer issues using a similar approach to troubleshooting any other issue.

- The initial problem description may not describe the actual situation well enough for you to resolve the issue. Asking additional questions can gain more information.

Most printer issues fall into one of several broad categories:

- Jams and misfeeds
- Network connectivity
- Perception
- Power and POST
- Print quality
- Software

Dell workgroup lasers have two diagnostic modes:

- Customer mode is accessible to customers.
- Developer/CE mode is reserved for trained and qualified technicians.

Printer diagnostics are built into the printer firmware.

- Digital input (DI) tests (sensors)

- Digital output (DO) tests (sensors, motors, and other components)
- Manual feed tests run with no sensor interaction. The media feeds completely through the path with no gap between pages.

Misfeeds and jams

- Misfeed — failure of the media to enter the feed path correctly
- Jam — an error condition that occurs when a sensor indicates the unexpected presence or absence of media

Misfeeds are likely to be caused by:

- Worn or dirty take-up (or pick) rollers
- Inappropriate printer or printer driver settings
- Improperly loaded media
- Inappropriate media

Because misfeeds can result in jams, they share many of the same causes. Additional causes of jams include:

- Motors
- Sensors
- Toner

When looking for the jam location, remember that the sensor indicated in the error code only detected that a jam had occurred. The source of the jam may be before or after the sensor in the feed path.

When clearing jams, be sure to clear the length of the feed path. Jams can result from debris in the path, and they can generate more debris, especially if they damage the media.

Don't forget to check the media. Most jams are caused by inappropriate, damaged, or improperly stored media.

Image quality issues can result from more than one condition:

- Contamination
- Configuration
- Device failures
- Media quality
- User expectations and perceptions

Noise issues can result from any moving part in the printer.

Media characteristics that can affect print quality and cause jams include:

- Curl — the tendency of media, especially paper, to curve at its edges. It usually results from excess moisture content.

- Fiber Content

Paper designed for laser printers is usually made from 100% chemically-pulped wood. The amount of fabric, such as cotton, a paper contains is called its rag content.

Rag papers may be esthetically pleasing, but they can decrease print quality.

- Grain direction
- Moisture content
- Paper Dust and Contaminants
- Recycled Paper
- Smoothness
- Weight and size

Review

Introduction

Congratulations on finishing this course!

Only two steps remain:

1. Review the following pages to prepare for the assessment.
2. Pass the assessment with a score of 80% or higher.

Module 1 (Introduction to Workgroup Printing)

Install laser printers in a safe, accessible location with adequate ventilation.

- Allow for adequate ventilation.
- Make sure the surface is stable and can support the weight of the printer.
- Make sure all trays, doors, and panels are accessible.
- Do not use a power strip or UPS.

The qualities that make a printer a workgroup printer have a lot in common with what makes a computer a server.

- Workgroup laser printers serve large groups of people and are designed to function well under heavy workloads.
- Multifunction printers incorporate a scanner and fax modem into the printer.

Printing to a workgroup laser printer involves many potential points of failure.

- The client system
- The network infrastructure
- The printer's electronic subsystem (ESS)
- The printer's imaging engine
- The printer's media handling subsystem
- The physical media

Module 2 (Printing Process)

Applications interact with the operating system, which interacts with the driver to communicate with the printer.

- Users can configure the printer driver with dialog boxes.
- Settings from the dialog boxes are applied in a specific hierarchy.

PDLs (Page Description Languages)

- PDLs describe how a printed page should look to the printer.

Dell workgroup laser printers can:

- Connect directly to a print server using a USB cable
- Connect to a print server over the network
- Function as their own print server when connected to a network

Xerography is a standardized technology, but specific details may vary among printers.

- Charge
- Expose
- Develop
- Transfer
- Neutralize
- Fuse
- Clean

Color Printing

- Printers use a subtractive process to create color. The more colors, the darker the image.

Dell printers use two different compositing methods:

1. Rotary compositing

- All four color toner cartridges mount in a cylinder.
- Each cartridge rotates past the imaging drum.
- Color composites on an intermediate belt.
- The developed image transfers from the belt to the media.

2. Tandem xerography

- Prints all four colors sequentially, using separate charge rollers, drums, and transfer rollers for each color

5000-series color lasers use a variant form of tandem xerography.

- Each color images onto a separate drum.
- Two intermediary drums (IDT1) composite yellow with black and cyan with magenta.
- Another transfer drum (IDT2) composites the two-color images from the intermediary drums.
- The media picks up the composited image from IDT2.

The media path is the route the media follows through the printer.

- Rollers keep the media moving through the feed path. Each printer has a unique set of rollers.
- The fuser assembly is comprised of the heat roller and the pressure roller.
- Duplexers enable printers to print on both sides of the media.
- The exit tray receives the finished documents. Some printers have multiple output bins.

Sensors at various locations detect the presence or absence of media and can cause:

- A false paper-out error if the sensor cannot detect the presence of media in the tray
- A false jam if the printer thinks it has media and another sensor reports that the media did not arrive or depart as expected

Module 3 (Networking Workgroup Printers)

All Dell workgroup laser printers support an Ethernet connection. Many also offer an optional wireless adapter.

- Early 3000- and 5000-series printers use a USB dongle installed into the printer's multiprotocol card (MPC). The MPC is a separate option in 3000-series printers.
- The most recent 5000-series printers support a wireless adapter that installs directly into a slot in the printers system board. The card supports both ad hoc and infrastructure 802.11b/g networks.

Location

- Networked laser printers require a stable, well-ventilated location where users can easily retrieve print jobs and replenish media.

Print server connection options include:

- Connecting directly to a print server using a USB or parallel cable
- Connecting to a print server over a wired or wireless network
- Connecting directly to a wired or wireless network and use the printer's internal print server

Dynamic Host Control Protocol (DHCP)

- Dell workgroup laser printers default to DHCP, but you can set a static IP address if needed.

All Dell workgroup laser printers feature a Web server (EWS) embedded in their firmware.

- The EWS enables you to monitor and manage the printer remotely.
- You can accomplish any task through the EWS that you can accomplish through the printer's menu system.

ColorTrack™ was originally implemented in the driver and suffered the limitations of a driver-based solution.

Because ColorTrack2 resides on the printer, it offers much tighter control over color printing than the original version.

OpenManage™ Printer Manager (OMPM) is recommended for managing large printer fleets. It is a server-based application and database that:

- Monitors Dell and non-Dell printers on the network
- Consolidates the data in a single location
- Provides configurable reports and alerts
- Facilitates communication with dell.com to reorder consumables

Module 4 (Troubleshooting Workgroup Printers)

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- Grain direction
- Moisture content
- Paper dust and contaminants
- Recycled paper
- Smoothness
- Weight and size

Conclusion

This concludes the Review module.